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NAVAL POSTGRADUATE SCHOOL
Monterey, California



THESIS

**IMPLEMENTATION OF A PRICING SYSTEM FOR
DECISIONNET**

by

Maxwell M. Chi

June 1999

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IMPLEMENTATION OF A PRICING SYSTEM FOR DECISIONNET

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**Submitted in partial fulfillment of the
requirements for the degree of**

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ABSTRACT

This thesis describes an implementation of DecisionNet which uses updated, more efficient web technology and includes a pricing system. DecisionNet is an organized electronic marketplace of Internet-accessible decision support systems. Providers register their decision support technologies in a online index. When consumers need a particular type of decision support system that they do not have, they can search the index to locate a system accessible over the web which might meet their needs, thus avoiding the purchase of a stand-alone system.

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I. INTRODUCTION

This thesis is intended to describe a proposed design of DecisionNet, which is an Internet-based decision support technology integration system. DecisionNet provides a means to bring providers and users of decision support technologies together on the World Wide Web in a way that is advantageous to both sides.

A. DESCRIPTION OF DECISIONNET

A decision support system (DSS) is “an interactive, flexible, and adaptable computer based information system specially developed for supporting the solution of a nonstructured management problem for improved decision making. It uses data, provides easy user interface, and can incorporate the decision maker’s own insights.” (Turban, P. 77). Three examples of decision support systems are online analytical processing (OLAP) tools which enable analysts to retrieve, manipulate, and display data from central databases; analysis information systems which provide the capability to synthesize information from several databases and develop small models; and optimization systems in which users enter constraints and desired objectives and receive recommended solutions. The major components of a DSS are a database and database management system (DBMS), a model base, and a user interface. The DBMS retrieves information from the database and generates reports. The model base contains standard and custom models written specifically for the DSS. The user interface is the means by which the user interacts with the DSS.

Individuals, companies, and universities have developed many decision support systems for their own and outside use. Some are highly specific, designed to solve

problems in very specialized areas. Others are more general, applicable to a wide variety of different fields which share a common problem-solving methodology. When a person or group is faced with a management decision, it is likely that some or all aspects of a DSS which already exists could help in finding a solution. But it may not be cost effective for that user to purchase an entire DSS to use just occasionally. It would be much more economical to "rent" a DSS just when it's needed. At the same time, developers of DSSs could benefit financially by "renting out" their systems on an as-needed basis to customers. Until recently, however, there was no vehicle to bring together developers and users of DSSs.

DecisionNet is an organized electronic marketplace of Internet-accessible decision support systems. The marketplace serves to bring together providers and consumers of decision support technologies in transactions. Providers register their technologies in an online index. Consumers can search the index to find a technology that meets their needs, and DecisionNet then directs them to that technology so that they can execute a transaction - that is, use the decision support system. The decision support technologies reside on provider machines distributed across the Internet. Most of the transactions are performed with hypertext transfer protocol (HTTP), but other Internet protocols such as file transfer protocol (FTP) and telnet are also used.

B. IMPLEMENTATION OF DECISIONNET

As a practical matter, DecisionNet must collect and record certain information about the people using it. Each person must register with DecisionNet and select a user identification and password. This provides a means of identification and authentication.

DSS providers also provide their home page uniform resource locator (URL), and DSS users, or consumers, provide their electronic mail (email) address. All of this information is stored in a database. Consumers and providers must log in each time in order to use DecisionNet. DecisionNet also records when and how long each provider and consumer has been logged on to the system. When a provider adds a new DSS to DecisionNet, the system asks for the URL and some descriptive information about the DSS so that consumers can decide whether the DSS suits their needs. All of these functions can be performed by manipulation of records in a database (addition, modification, and deletion). Therefore DecisionNet is implemented as a database application, with a web-based user interface and links to the URLs of the various DSSs.

C. PREVIOUS WORK

The first implementation of DecisionNet was by Bhargava et al. (1995) using a Hypertext Markup Language (HTML) search engine with Practical Extraction and Report Language (PERL) scripts. Earley (1996) accomplished the second implementation, using a relational database with Common Gateway Interface (CGI) scripts to perform the data retrieval and manipulation. At that time, Earley mentioned that the “linkage between a DBMS and the WWW is a relatively unexplored aspect of Web applications.” As will be described a bit more later, the technology has advanced considerably since then.

Earley’s implementation did not include pricing and financial accounting features. It assumed that all DSS services would be provided free of charge and left pricing as a subject of future research. The present work implements a simple, flexible pricing system

which enables providers to set subscription- and usage-based prices for each of their technologies, and also to package two or more technologies under one set of prices.

D. PRESENT WORK

The present work is intended to describe a new implementation of DecisionNet using Microsoft Active Server Pages. The contributions of this work are twofold:

- 1) It duplicates the major functionality of Earley's previous implementation but uses updated, more efficient web technology. The previous implementation used CGI scripts to retrieve information from a database and generate web pages dynamically based on that information. Although state-of-the-art at the time, this method is now considered inefficient because each CGI request causes a new process to be spawned, and after the request has been handled, the process is terminated. If more than a few people are accessing the application simultaneously, this can create excessive overhead on system resources. The present state of the art is the Internet Server Application Programming Interface (ISAPI) which enables the server to spawn just one process to serve all requests.
- Active Server Pages (ASP) is a Microsoft technology that greatly simplifies the use of ISAPI. ASP enables both browser and server scripts written in JavaScript or VBScript to be embedded in web pages, side-by-side with the HTML code. Like CGI, these scripts enable the web pages to be generated and updated dynamically, but they operate more efficiently. For example, browser scripts can validate user inputs to a form and generate error messages as appropriate without requiring any involvement from the server; server scripts can retrieve and update data and require just one connection to the database, instead of a separate connection for each request.

2) It incorporates a simple pricing mechanism by which DSS providers may set prices for use of their systems over the WWW and consumers' accounts would be charged accordingly as they used those services. A literature search of academic studies and actual pricing schemes revealed no general consensus on the optimum or most appropriate method to price Internet services. Consequently, the pricing system is designed to be flexible. Providers may offer monthly subscriptions, or they may charge by number of accesses, number of pages downloaded, or number of minutes online, or they may choose a combination of all of these. The individual prices are also set by the provider and can be changed at any time.

Earley made a distinction between independent technologies and exclusive technologies. Independent technologies include their own interface, execution control, and overhead functions and can therefore operate independently of DecisionNet. DecisionNet merely contains links to the URLs of those technologies. Exclusive technologies are those for which DecisionNet provides the interface, execution control, and overhead functions and must be run exclusively through DecisionNet. Like Earley's implementation, the present system would only accommodate independent technologies. The database design could be expanded in the future to incorporate exclusive technologies; again, this is left as a topic for further research.

II. ENTITIES, FUNCTIONS AND DATABASE DESIGN

This chapter describes the basic DecisionNet model in terms of its entities and the functions performed by and on those entities. There are three main entities -- consumers, providers, and technologies. Providers register their decision support technologies with DecisionNet and consumers use them. In order to monitor usage and perform necessary accounting, we also introduce "active" consumers and providers. Active consumers and providers are those presently logged into DecisionNet. Additionally, providers may choose to bundle, or package, two or more technologies in order to make all of them available for one set of prices. These packages are also represented as entities in the database.

A. ENTITIES

- Consumer: a person who is registered to use DecisionNet DSS technologies
- Provider: a person or organization which is registered to provide DSS technologies
- Technology: a DSS that is able to operate over the WWW through DecisionNet
- Package: a group of two or more technologies that share a pricing scheme
- Active Consumer: a consumer who is presently logged into DecisionNet
- Active Provider: a provider who is presently logged into DecisionNet

B. FUNCTIONS

The DecisionNet system provides for four categories of functions. Consumer functions pertain to consumers of DSS technologies. Provider functions relate to DSS providers. Administrative functions are system and database administration tasks that are performed by the DecisionNet administrator. Finally, general functions are performed by all groups of users.

1. Consumer Functions

- List Technologies: provide a list of all registered technologies, ordered by some characteristic
- Search Technologies: find those registered technologies that satisfy some criteria
- Access Technologies: run a technology through the DecisionNet interface
- Review Account Information: display the consumer's charge balance and technology usage
- Bookmark Technologies: mark frequently used technologies for quick access

2. Provider Functions

- Register Technologies: add a technology to DecisionNet
- Modify Technology Information: review and change information about registered technologies
- Register Packages: create a new package consisting of two or more registered technologies

- Withdraw Technologies: remove a technology from DecisionNet
- Delete Packages: remove a package
- View Technology Usage: display usage information for each technology registered by that provider

3. Administrative Functions

- Browse DecisionNet Tables: view layout and contents of all tables in the database
- Log Out Users: remove consumers and providers who are not using DecisionNet but are still logged in

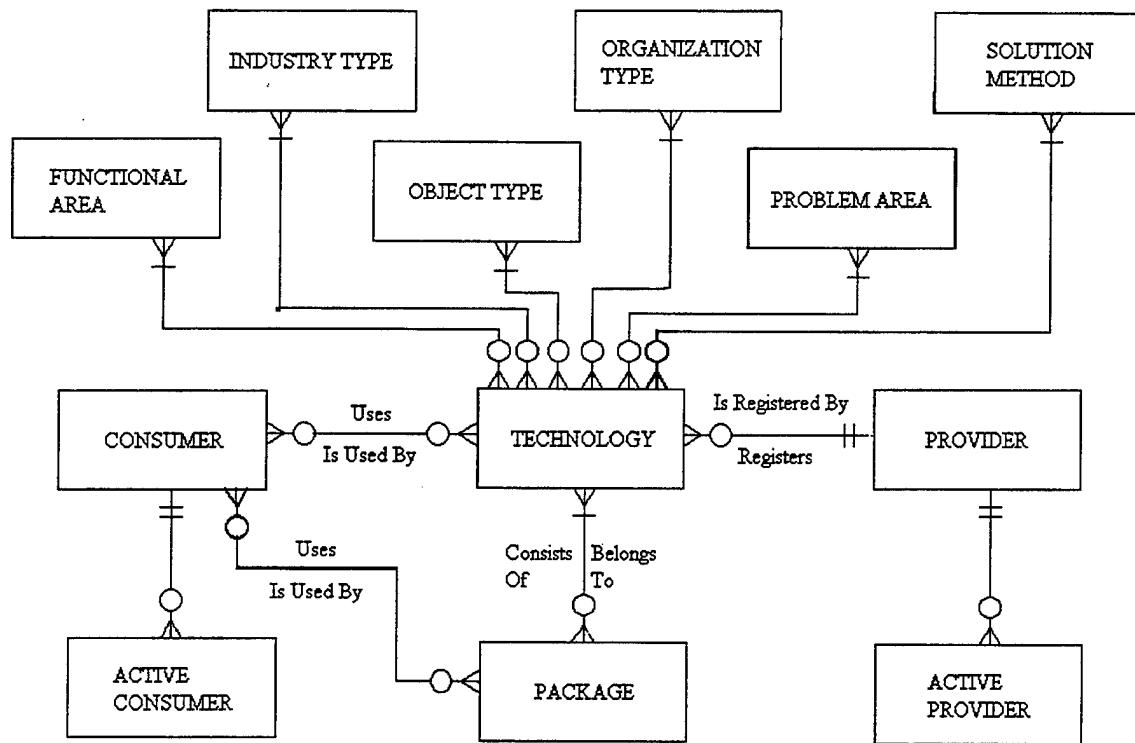
4. General Functions

- Register: establish a DecisionNet user ID and password
- Withdraw from DecisionNet: cancel a registration
- Login and Logout: identify and authenticate oneself to DecisionNet by entering a user ID and password
- Review and Modify Registration Information: change identification information and password

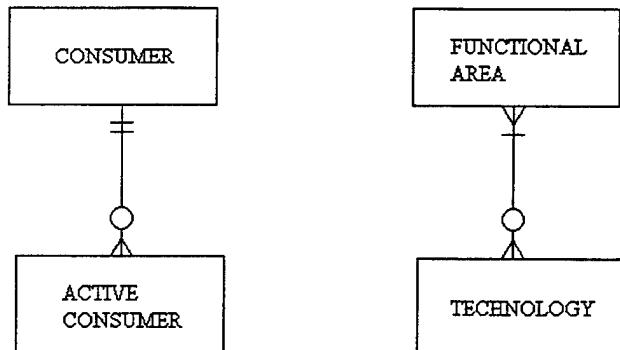
C. DATA MODEL

The Entity-Relationship (ER) diagram for DecisionNet appears in Figure 1. The main entities are the Consumer, Provider, Technology, and Package. The ER diagram was generated using Visible Analyst Workbench (1996).

The Technology table and Provider table are in a one-to-many relationship, since each technology is registered by one provider, and each provider can register zero, one, or many technologies. The present implementation assumes that each technology is registered by exactly one provider. In the future the database may be modified to allow for the possibility of a technology registered by two or more providers; in that case additional entities and relationships may have to be introduced into the database to accommodate that possibility. The Consumer and Active Consumer tables are also in a one-to-many relationship, since each record in the Active Consumer table corresponds to one and only one consumer, but each consumer can be logged on more than once and thus generate many records in the Active Consumer table. The six taxonomy tables, Functional Area, Industry Type, Object Type, Organization Type, Problem Area, and Solution Method, each have a one-to-many relationship with the Technology table. This is because there may be zero, one, or many technologies that belong to each category, but each technology only belongs to one category of each taxonomy. (Actually, each technology may belong to one or to all categories of each taxonomy, so the relationship is depicted as many-to-many in the diagram.) Finally, Consumer and Package each have a many-to-many relationship with Technology. Each consumer may use zero, one, or many technologies, and each technology may be used by zero, one, or many consumers. Likewise, each technology may belong to zero, one, or many packages, and each package consists of two or more technologies. These many-to-many relationships are handled by correlation tables in the database.



Key to symbols in the Entity-Relationship Diagram:



This means that each instance of Active Consumer relates to exactly one instance of Consumer, and each instance of Consumer relates to zero, one, or more than one instance of Active Consumer

This means that each instance of Technology relates to one or more than one instance of Functional Area, and each instance of Functional Area relates to zero, one, or more than one instance of Technology

Figure 1. E-R Diagram

D. DATABASE TABLES

1. Consumer and Provider Tables

The Consumer table has a unique identifying field (primary key) named ConsumerID. This is a 15-alphanumeric character identifier chosen by the consumer at the time of registration. Additionally, this table contains the consumer's chosen password, last name, first name, email address, and current account balance. The Provider table has a primary key of ProviderID and a password. It uses only one field for the provider's name (individual or business name) and also includes the provider's home page URL and email address.

2. Technology Table

A composite primary key is a combination of two or more fields that uniquely identify each record in a table. The Technology table has a composite primary key of ProviderID and a TechName, which is a unique identifier assigned by the provider to that technology. It has six taxonomy classification fields (ObjectTypeID, ProblemAreaID, FunctionalAreaID, SolutionMethodID, IndTypeID, and OrgTypeID) which are foreign keys tied to the primary keys of the six taxonomy tables. (A foreign key is a field that refers to the primary key in another table.) The table also contains the technology URL, a field indicating whether the technology is exclusive or independent, the date the technology was registered, and the date it was last updated. The table also contains pricing information chosen by the provider.

3. Active Consumer and Active Provider Tables

These two tables are for the purpose of keeping track of users who are not actively using DecisionNet but are still logged in. They contain the ConsumerID or ProviderID and the session start time. If the session start time is 24 hours ago or longer, the user is assumed to be no longer actively using DecisionNet and is automatically logged out.

4. Package Table

This table records technology packages created by the provider. It has a composite primary key of ProviderID and PackageName, both of which are unique 15 character identifiers. It also contains pricing information for that package.

5. Bookmarked Technologies Table

This table records the technologies that a consumer has marked for quick access. It contains a composite primary key of ConsumerID, ProviderID, and TechnologyorPackageName.

6. Technology Use

This is a correlation table between Consumer and Technology, and between Consumer and Package. In the ER diagram of Figure 1, the Consumer and Technology entities are in a many-to-many relationship, as are the Consumer and Package entities. Rather than have two separate correlation tables, the Technology Use table serves as an intermediary for both relationships. It contains a composite key of ConsumerID, ProviderID, and TechnologyorPackageName; a field indicating whether the consumer is subscribed to that technology or package; the date the consumer subscribed; and usage

information.

7. Consumer Mirror, Provider Mirror, Technology Mirror, and Package Mirror

These tables are identical in design to the Consumer, Provider, Technology, and Package tables, respectively. Each of the mirror tables provides a historical listing of information on an entity, even if the entity withdraws from DecisionNet. For example, if a consumer withdraws from DecisionNet, that consumer's ID remains in the Consumer Mirror table for archival purposes.

8. Package-Technology Table

This is a correlation table between the Package and Technology entities, which are in a many-to-many relationship. Each row of this table contains a Provider ID, the name of a package created by that provider, and the name of a technology that belongs to that package.

9. Taxonomy Tables

These tables indicate the taxonomy categories for the technologies as developed by Patricia Rogers (1996). They each contain a primary key identifying the category and the name of the category.

10. System Administrator Table

This table contains only the DecisionNet administrator's login ID and password. It is used for identification and authentication of the DecisionNet administrator.

III. PROCEDURES TO EXECUTE DECISIONNET FUNCTIONS

This chapter describes the procedures to perform DecisionNet functions and user commands. Section A describes the hardware, software, and operating system of the platforms on which this implementation of DecisionNet would operate. Section B describes each of the procedures.

A. PLATFORMS AND PROGRAMMING LANGUAGES

Earley's implementation of DecisionNet was accomplished in 1996 using CGI scripts programmed in Delphi for Windows. At that time, making data stored in databases available over the World Wide Web was a novel idea and there were very few options for carrying it out. Since then, there has been exploding demand for ways to interface data with the World Wide Web. Businesses and organizations of all sorts need to enable their staff and customers to view and modify data through the web. Dynamic rather than static web pages have become the norm. Industry responded to this demand by providing a variety of platforms and programming tools to build such pages. Sun Microsystems, Oracle, and Microsoft are three of the most widely used manufacturers. Each of these companies offers a myriad of different tools and options. For example, Sun has released three different versions of the Java Software Development Kit (SDK); all three are in use and each has somewhat different functionality for displaying graphics on the web. Oracle presently offers WebDB, Developer, and Express as ways of developing data-aware web pages, and a web version of Discoverer, which is another database query tool, is expected soon. Likewise, Microsoft offers Active Server Pages, Dynamic HTML (DHTML) applications, Internet Information Server (IIS) applications, and ActiveX documents.

Active Server Pages are HTML pages built with standard HTML editors, combined with server-side code written in VBScript to build Structured Query Language (SQL) queries and retrieve the results from the database. They require Microsoft IIS or Personal Web Server to run, but no special software on the server. The present implementation of DecisionNet was programmed with Active Server Pages using a Windows 98 personal computer. Most of the pages can be accessed and viewed with any web browser; however, in order to display the providers' technologies, the Microsoft Web Browser Control is used and this control requires Microsoft Internet Explorer version 4.0 or higher.

B. DESCRIPTION OF PROCEDURES

The procedures are divided into four groups, according to whom they service: new user (not registered as a consumer or provider); consumer; provider; or DecisionNet administrator.

1. New User Procedures

a. Browse Technologies

This procedure can be executed from the opening screen of DecisionNet, before the user has registered or logged in. It just returns an alphabetized list of the names of all DecisionNet technologies, along with their provider names, object types, and problem areas.

b. Register as Consumer

This procedure enables a user to establish a new Consumer ID and password. The registration form asks the user to enter a Consumer ID, a password, last name, first name, and email address. The procedure performs these steps:

- Verify that the user's selected Consumer ID does not already exist in the Consumer or Consumer Mirror table. If it does, prompt the user to select a different Consumer ID and return to the registration form
- Verify that the Consumer ID, password, names, and email address were all entered. If any data is missing, notify the user to fill in all required information and return to the registration form
- Enter data into the Consumer, Consumer Mirror, and Active Consumer tables.
- Display a form indicating that the user is logged in as a consumer with the Consumer ID selected

c. Register as Provider

This procedure enables a user to establish a new Provider ID and password. The registration form asks the user to enter a Provider ID, a password, a name, home page URL, and email address. The procedure performs these steps:

- Verify that the user's selected Provider ID does not already exist in the Provider or Provider Mirror table. If it does, prompt the user to select a different Provider ID and return to the registration form
- Verify that the Provider ID, password, name, home page URL, and email address were all entered. If any data is missing, notify the user to fill in all required information and return to the registration form

- Enter data into the Provider, Provider Mirror, and Active Provider tables.
- Display a form indicating that the user is logged in as a provider with the Provider ID selected

2. Consumer Procedures

a. *Consumer Menu*

The consumer menu is the starting point for all actions carried out by a consumer. This form enables the consumer to search and list technologies, access any registered technology, modify his login information, and view his account information.

The specific actions that a consumer can perform are:

- **List Technologies:** Enable the consumer to view a list of all registered DecisionNet technologies, sorted by technology name, provider name, object type, or problem area
- **Search Technologies:** Enable the consumer to search for technologies that match his choices for each of the six major categories in the taxonomy (object type, problem area, functional area, solution method, industry type, and organization type)
- **Modify Consumer Information:** Enable the consumer to view and modify his DecisionNet registration information
- **Account Information:** Enable the consumer to view his financial DecisionNet account information
- **Withdraw:** Enable a consumer to permanently close his account with DecisionNet

- **Logout:** Enable a consumer to end his active consumer session
- **View Details:** Enable the consumer to view the details of a specific technology
- **View Usage Charges:** Enable the consumer to view the charges associated with using a specific technology
- **Access Technology:** Enable the consumer to access a DecisionNet technology

b. List Technologies

The list technologies procedure is similar to the browse technologies procedure described previously. The only difference is that the list technologies procedure enables the consumer to view details of a specific technology if desired. The procedure performs these steps:

- Build a list of technologies, using a SQL statement, sorted by the fields the consumer has selected
- Display the list, along with the option to view details on a specific technology or to return to the consumer menu

c. Search Technologies

This procedure receives the consumer's choices of the six major categories in the DecisionNet taxonomy and lists all technologies that match the choices. This is not a true indexed search in that it does not find any technologies that are close to, but not exactly, the consumer's choice; it only returns exact matches. The user has the option to select "All" for any or all categories, which sets no limiting criteria for that category.

Additionally, some technologies may have "All" specified for one or more categories. For

example, a technology that has “All” specified for the Organization Type is considered valid for all organization types. The procedure performs these steps:

- Execute a SQL query on the Technology table to select any technologies that exactly match the consumer’s criteria
- Display the results of the query, along with the option to view details on a specific technology or to return to the consumer menu

d. Modify Consumer Information

This procedure enables the consumer to change the information that he specified at registration. The only field that cannot be changed is the Consumer ID. The procedure performs these steps:

- Display a form for the consumer’s registration information, showing current values except the password
- Verify that the value entered for the current password is correct. If it is not, prompt the user to type the current password again
- If the current password is correct, update the Consumer and Consumer Mirror tables with the new information

e. View Account Information

This procedure displays a screen showing the consumer’s present account balance and technology usage by date and time. It also lists the technologies to which the consumer is presently subscribed.

f. Withdraw from DecisionNet

This procedure permanently removes a consumer’s record from the Consumer table, but leaves the record intact in the Consumer Mirror table for archival

purposes. The consumer is informed that he must choose a different Consumer ID should he register again in the future. The procedure performs these steps:

- Remove the consumer's record from the Consumer and Active Consumer tables
- Display a form indicating that the consumer has been withdrawn

g. Logout

This procedure ends the consumer's active DecisionNet session. It performs these steps:

- Remove consumer's record from the Active Consumer table
- Display a form indicating that the consumer has been logged out

h. View Details

This procedure is accessed from the list technologies and search technologies procedures. It performs these steps:

- Receive the name of the technology that the consumer has highlighted in the list displayed by the list technologies or search technologies procedure
- Display a form showing the information that the provider specified for this technology, including the dates it was registered and last updated, the category to which it applies within each of the six taxonomies, purpose, and comments. The form also gives the consumer the option to view usage charges, to bookmark the technology for quick access in the future, and to return to the consumer menu

i. View Usage Charges

This procedure is accessed from the view details procedure. It shows the charges that the provider has specified for the use of this technology. It also shows any

packages of which the technology is a part, and the charges specified for each package.

The consumer must accept one of these sets of charges in order to access the technology.

The procedure performs these steps:

- Receive the information on the technology from the view details procedure
- Execute a SQL query on the Technology and Package tables to retrieve the technology charge information as well as charge information on any packages to which this technology belongs
- Display this charge information in a form. The form also includes buttons to accept either the technology charges or one of the package charges. When one of the buttons is clicked, the consumer agrees to be charged and can access the technology

j. Access Technology

This procedure is called from the view usage charges procedure. It opens the technology's page in a web browser window. The browser window is part of DecisionNet, and when the consumer closes the window, he is returned to the DecisionNet consumer menu. This procedure performs these steps:

- Receive the technology information from the view usage charges procedure
- Send the consumer to the independent technology in a browser window
- Update the Technology Use table and Consumer table to record the consumer's usage information

3. Provider Procedures

a. Provider Menu

Like the consumer menu, the provider menu is the starting point for all actions performed by a registered provider. The menu provides a means to register, update, and withdraw technologies; modify registration information; view technology usage information; and logout and withdraw from DecisionNet. The specific that a provider can perform are:

- **Register New Technology:** Enable the provider to register new technologies
- **Update Technology Information:** Enable the provider to modify registration and pricing information on his technology
- **Withdraw Technology:** Enable the provider to remove a technology from DecisionNet
- **Create New Package:** Enable the provider to create a bundle, or package, consisting of two or more technologies, with a single pricing scheme
- **Delete Package:** Enable the provider to withdraw a package
- **View Technology Usage Information:** Enable the provider to view data on use of his technologies and packages by consumers
- **View Account Information:** Enable the provider to view his account balance
- **Modify Provider Information:** Enable the provider to modify the information that he provided at registration
- **Withdraw:** Enable the provider to permanently close his DecisionNet registration

- **Logout:** Enable the provider to end his active provider session

The latter three actions are nearly identical to the corresponding consumer actions, except that they pass Provider ID instead of Consumer ID and operate on the Provider table instead of the Consumer table. These procedures will not be described here.

b. Register Technology

This procedure supports entering a new technology into the DecisionNet database. It performs these steps:

- Display a form for the provider to enter a Technology ID and URL for the new technology, select from drop-down lists for the six major taxonomy categories, and optionally enter purpose and comments
- Verify that the Technology ID has not already been assigned to another technology or package by this provider, and that all required fields are filled in
- Append a new record to the Technology and Technology Mirror tables
- Send the provider to the pricing information procedure

The pricing information procedure performs these steps:

- Display a form for the provider to enter either usage-based or subscription price for the new technology
- Verify that all pricing information entered is valid numerical data
- Update the record in the Technology and Technology Mirror tables with the pricing information
- Return the provider to the provider menu

c. Update Technology Information

This procedure enables the provider to modify information relating to one of his registered technologies. The procedure performs these steps:

- Display a list of technologies that a provider has registered and ask him to select which technology to update
- Display a form showing current information on that technology. The provider can modify any of the fields except the Technology ID
- Update the Technology and Technology Mirror tables with the new information
- Display a form showing current pricing information on that technology. The provider can change the pricing scheme and amounts
- Update the Technology and Technology Mirror tables with the new information
- Return the provider to the provider menu

d. Withdraw Technology

This procedure removes a technology from DecisionNet. It only removes the information from the Technology table, leaving the record intact in the Technology Mirror table for archival purposes. The procedure performs these steps:

- Display a list of technologies that the provider has registered and ask the provider to select a technology to withdraw
- Verify that removing the selected technology would not leave any packages containing just one technology

- Remove the Technology from the Technology, Bookmarked Technologies, and Package-Technology tables
- Return the provider to the provider menu.

e. Create New Package

This procedure creates a new package, or bundle, consisting of technologies registered by this provider. It performs these steps:

- Display a form asking the provider to assign a name to the new package and to select two or more registered technologies to assign to the package. The form also asks the provider to enter pricing information to the package
- Search the Technology, Technology Mirror, Package, and Package Mirror tables to verify that the package name has not previously been assigned to another package or technology, and verify that all pricing information is valid numerical data
- Update the Package, Package Mirror, and Package-Technology tables
- Return the provider to the provider menu

f. Delete Package

This procedure removes a package from DecisionNet. It only removes the information from the Package table, leaving the record intact in the Package Mirror table for archival purposes. It performs these steps:

- Display a list showing the packages that the provider has created and the technologies assigned to each. Ask the provider to select a package to delete
- Update the Package and Package-Technology tables
- Return the provider to the provider menu

g. View Technology Usage Information

Displays tables of data on use of the provider's technologies and packages by consumers.

h. View Account Information

Displays a screen showing the provider's account balance.

4. Administrator Procedures

a. Browse DecisionNet Tables

This procedure enables the administrator to view any of the tables in the DecisionNet database. The procedure performs these steps:

- Receive the Administrator identification and password
- Display a dropdown list of DecisionNet tables enabling the administrator to select a table
- Display the selected table on a dynamic HTML page, along with the dropdown list again

b. Timeout Procedure

This procedure deletes records from the Active Consumer and Active Provider tables for users who logged in more than 24 hours ago. The majority of users in this category are those who left DecisionNet and neglected to log out. The procedure performs these steps:

- Receive the Administrator identification and password
- Remove all records from the Active Consumer and Active Provider tables where the Log In time is more than 24 hours prior to the current system time

- Display a message to the administrator showing the number of records deleted from each table

IV. PRICING

The emergence of the Internet in the last few years has posed both unique opportunities and unique problems for sellers of goods and digital services. For the first time merchants have the ability to connect and transact business with customers all over the world. But the Internet is a unique transaction medium and requires a new pricing model. Economists have studied and proposed new theories and pricing schemes tailored for the online market. DecisionNet presents an opportunity to explore new pricing schemes in a practical setting.

DecisionNet is an example of an Internet-based “information goods” delivery system. Over the last several years the Internet has developed into a highly efficient means of distributing information and services, such as news, documents, music, and, as in this case, software. It is a fast growing market worldwide: the percent of the U.S. population over 18 who regularly use the WWW grew almost linearly from 10 percent in the second quarter of 1992 to 40 percent in the third quarter of 1998. An Internet usage monitoring web site maintained by ITM Solutions Inc.

(http://www.lsilink.com/usage_regions.html) reported that in February 1998 there were 8.5 million web users in Latin America, up from 5.5 million in July 1997; about 700,000 in the Middle East; and 5 to 10 million in the Pacific Rim. A survey conducted in September 1998 (InternetTrak, 1998) showed that in western Europe, seven million people, or about 15 percent of the population over age 18 regularly use the web and another one million begin using it every six months.

Furthermore, web users do more than just surf: the survey reported that in Europe, 1.6 million had bought a product or service over the Web in the preceding three months, 2.9 million expected to spend more on on-line purchasing in the next year than the last year, and 3.3 million gathered information on the Web and then made a purchase on or off-line. The ITM Solutions site reports that worldwide in 1996, \$2.6 billion dollars (U.S.) worth of transactions were conducted via the web from more than 32 million devices (PC's, Net-TV, etc.) and that more than 50% of all remote commerce transactions are conducted on the web (as opposed to fax or phone). Non-US markets are poised for the largest growth.

All of this means that the Internet promises a way of reaching out to a truly global mass market. It is a unique market: although conventional consumer goods sold via the Internet can be priced by standard economic theories, providers of digital information goods face an unprecedented situation and are considering a variety of revenue models. Because perfect copies of these goods can be created and distributed almost at no cost, some of the old rules, such as "price should equal marginal cost," do not apply (Varian, 1995).

A. ACADEMIC STUDIES

Ever since the declining costs and widespread availability of computers has begun to make online digital services widely available, the question of how to properly charge for information goods has attracted the attention of many economists. One of the groundbreaking studies, still commonly cited, was by Adams and Yellen (1976). They examined a hypothetical case of a monopolist selling two goods, and compared the cases

of pure bundling (offering only the complete bundle), unbundling, and mixed bundling (offering the complete bundle and subsets of the bundle). Using qualitative examples, they showed that pure and mixed bundling can often be more advantageous to the seller than unbundled sales. In particular, they had found that the profitability of bundling was greater when the consumers' valuation of the products in the bundle was negatively correlated, i.e., people with a higher valuation for one product would tend to have a lower valuation for another product, or only weakly correlated.

Toub (1995) discussed various issues related to pricing of information goods and compared the pros and cons of several pricing schemes, in the context of Internet search engines. He pointed out that as the Internet got progressively bigger, it was no longer possible for web search services such as Infoseek and Excite to rely on the efforts of part-time volunteers to catalog the web's contents. Rather, it was becoming necessary for them to hire full-time professionals trained in a variety of disciplines and to maintain an infrastructure to house and support the project and its staff. This meant the services had to have some way to recover their costs. He cited other authors who stated there were three ways for such services to recoup their costs: advertising; charging users for service; or charging content providers to be listed. He felt the latter option was not feasible.

Advertising, however, generated substantial revenue for major sites which had hundreds of thousands of hits per day. Netscape, for instance had \$1,766,000 in advertising revenue in the fourth quarter of 1995, while Lycos had \$1,296,000 and Infoseek had \$1,086,000. Of the \$12.4 million spent on Web advertising in the fourth quarter of 1995, over \$9.2 million (roughly 75%) went to the top ten sites. Sites with lower hit rates had a harder time generating advertising revenue. While SportsZone and

Netscape can charge \$20,000 for a monthly ad, smaller sites with only 1,000 visits per day can charge only around \$100 per monthly ad.

The other way to recover costs is to charge users. Toub states there are a couple of incentives besides income for sites to charge users for access: to ensure its providers stay responsive to user needs, and to assure users of the quality of its information, since consumers may be distrustful of anything that is provided for free. Toub describes several issues related to access pricing:

- The service can be viewed, and priced, at several layers of granularity: the individual link or citation, a list of links or search result, or use of the service as a whole.
- Publishers can choose to price the same service product differently for different uses and users. They can discriminate on the basis of “who you are.” Nonprofit or educational users may be charged less than business users. Active users may receive discounts, as may those who use the service at off-peak times. Groups of users may be priced differently than individual users. Or they may discriminate based on “what you want.” Some users may want a document/item immediately no matter the cost. Some may want the full journal or full article, or only a part of it. Documents of a better print resolution, a more labor-intensive format, or that have extra features such as active hyperlinks may be priced higher. Toub states that “By using nonuniform pricing, instead of all users paying their *average* share of costs (through a connection, or subscription charge), they will start to pay for something closer to their own *incremental* share of costs. This means that low-intensity users should see a *reduction* in their total payments; high-intensity users will pay more.”

Toub describes three ways to charge for access, and the advantages and disadvantages of each:

- Site license: Specific user groups pay a certain monthly or annual fee for unlimited access to the service. Advantages: some groups, such as schools and libraries, are accustomed to it; it provides predictable income for sellers and costs for users; sellers can tailor costs for different groups and also charge on a sliding scale. Disadvantage: sellers cannot price discriminate at the level of individual users.
- Individual subscription: Individuals pay a certain monthly fee for unlimited access to the service. Or a fee for a certain part of the service, and incremental fees when that content or time usage is exceeded. Advantages: allows publishers to track user preferences and usage; allows users to browse the service without time constraints; pricing is easily understood by the user. Disadvantage: Up-front subscription fees may be more than users are willing to pay.
- Fee for Use: Individuals pay a fee based for various units: e.g., access time, types of content browsed or downloaded. Advantage: Provides maximum benefits of nonuniform pricing. Disadvantages: The infrastructure required for a digital library that could charge users nanocash for time spent browsing or types of content browsed is not yet developed; for time-based pricing, users are likely to cut usage short since they are conscious of time spent using the service; pricing is confusing to users.

In recent years, more studies have been published. Typically these consist of formal, mathematical arguments in which various situations are quantitatively compared and

shown to favor one packaging scheme or another. Some examples of such studies are summarized below:

1. Advantages of Bundling and Aggregation

a. Bakos and Brynjolfsson

Bakos and Brynjolfsson (1997, 1998) examined the effects of bundling of information goods. They looked at the strategy of offering a diverse package of goods for a single price and found that in many cases the seller can obtain higher profits in this way than by selling each good individually. The reason, they explain, is that bundling reduces the seller's uncertainty of the buyer's valuation of the goods. With a vast market like the Internet, a seller cannot know the price every buyer, or even the majority of buyers, are willing to pay for each of his goods. The seller therefore charges some amount which is too high for some customers, causing him to lose their business, and too low for others, causing him to forego potential profit. By bundling goods together, the uncertainties offset to some extent. Buyers who find that the bundle price is too high for them for one product, often find that it is too low for them for another product and will buy the bundle. The effect is that the "variance" or uncertainty in the buyer's valuation for the bundle is lower than for each individual product. Figure 2 below illustrates the concept.

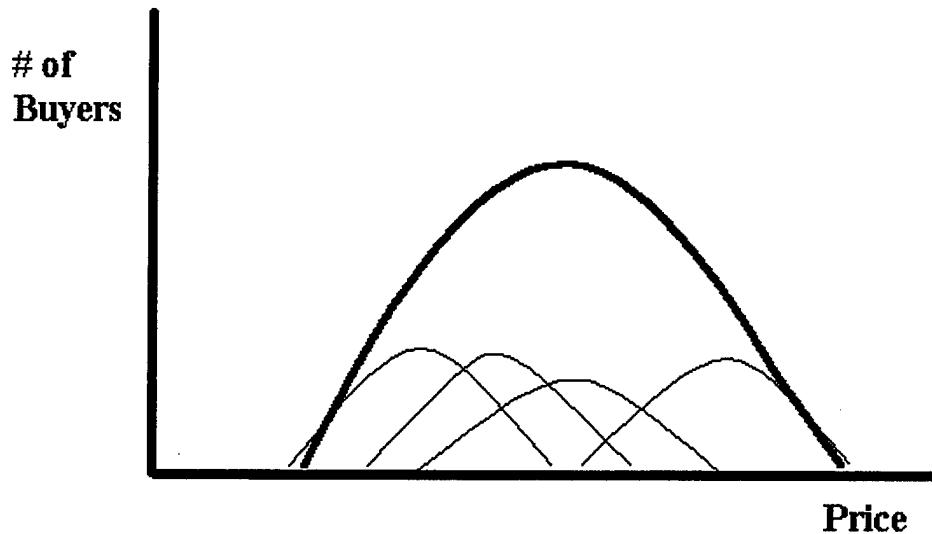


Figure 2. Variance Reduction with Bundling

The variance in buyer valuation is lower for the bundle than for each product individually. The more products are added to the bundle, the more the reduction in variance. Lower variance translates into greater profit for the seller, since he can set the bundle price close to the actual valuation for the majority of consumers. As the authors put it, “the law of large numbers guarantees that the distribution of valuations for the bundle has proportionately more mass near the mean ... such a reduction in ‘buyer diversity’ typically helps sellers extract higher profits from all consumers.” In view of Adams and Yellen’s earlier result that bundling is more profitable when consumers’ valuations are negatively correlated, it will be advantageous for the seller to bundle diverse groups of unrelated goods to help ensure this will be the case. Some other conclusions reported by Bakos and Brynjolfsson are:

- 1) When marginal costs of selling the goods are zero and consumers are largely homogeneous, bundling results in greater profits than selling each good individually.

The more goods that are bundled, the greater the profit. In the case of DecisionNet,

the marginal cost to the provider of serving one additional consumer is small, consisting of computer processing time. Consumers consist mostly of professionals and students in the physical and social sciences, a rather homogeneous group. Thus, this result applies.

- 2) If the number of goods is small, bundling all goods may not be the optimal strategy. It may be better to offer some goods outside the bundle.
- 3) If some goods have negative value to some consumers, then the benefits of bundling may be reduced or eliminated. A software product may have negative value to consumers, for example, if it does not follow the industry standard and therefore requires a steep learning curve. A DSS technology which does not follow the Windows standard would require time and effort by the consumer to learn, and therefore probably be rejected in favor of other technologies. Providers should keep this fact in mind.
- 4) If a good with high variance is included in the bundle, the profitability of the bundle may decrease. The authors cite the example of cable television services such as HBO, which offers access to hundreds of movies for a single price, but offers prize fights on a “pay-per-view” basis. The variance of the prize fight is higher than for movies: a small segment of customers are willing to pay a higher price than most to watch the fight. Thus, the higher variance good is offered separately from the bundle.
- 5) Often it is more advantageous to offer two or more bundles, each aimed at a target segment of consumers. For example, business users may value computers differently than home users. Thus, manufacturers such as Dell Computer Corporation offer different sets of prices for business and home customers. The authors point out it may

be necessary to offer the same goods in several bundles, each with a different price, reflecting the different valuations of different sets of consumers.

- 6) The authors state that “our model of aggregation can also be applied to dimensions such as time and space. For example, when the good can be costlessly provided over multiple time periods, it may be more profitable to sell it as a long-term subscription than to sell individual uses in short periods of time. Since a given user may sometimes have high valuations for the good and sometimes low valuations, per-use (or short-term) pricing might inefficiently exclude use during low-value periods, even when the cost of provision is zero. By charging a single subscription fee and giving the user long-term access to the good, greater efficiency and profits can result by an argument corresponding to those for bundling.”

Bakos and Brynjolfsson state that these results are general and can be applied by many sellers of information goods. They state that “bundling could be implemented by a broker that remarkets goods produced by information ‘content’ producers” or that “a consortium or consumers could purchase access to a variety of information goods and make them available to all members for a fixed fee.” Both of these examples are very similar to DecisionNet.

The authors point to several empirical examples to support their results. They cite differences between the Internet Shopping Network (<http://internet.net>) and E-library (<http://www.elibrary.com>). The Internet Shopping Network sells physical goods such as computer hardware, priced per unit. E-library sells information goods, which have nearly zero marginal cost of production, and makes them all available for a single membership fee. They also contrast cable and satellite television companies, which have

very low marginal cost and offer many movies for a single price, with video rental stores, which have higher marginal cost and charge per rental.

Thus it is advantageous for providers that DecisionNet offer the option to bundle their technologies. Because, as the above results show, no single bundling or pricing scheme will work in all cases, DecisionNet should be designed with maximum flexibility in the bundling and pricing options available. Providers should be able to choose which technologies to include in which bundles, which not to bundle, and what prices to charge. Additionally, DecisionNet should give providers the option to aggregate over time by offering subscriptions to technologies and packages.

One other result discussed by Bakos and Brynjolfsson is disaggregation over time, that is, charging different prices based on the time of day, month, or year. This is a strategy used by online stock services, which charge more during the day to business users who place a higher value on their services, and hotels, which have varying seasonal rates. This feature is not implemented in the present version of DecisionNet; it is left as a subject of future study.

b. Fishburn, Odlyzko, and Siders

Fishburn, Odlyzko, and Siders (1997) also favored subscriptions as opposed usage-based pricing. They disagreed with widespread expectations that electronic commerce for information goods would eventually move to usage-based pricing, so that users who downloaded news articles or used online software would be charged for each time they used it. Although they did allow for the possibility of usage-based pricing in certain cases, like Bakos and Brynjolfsson they believed that fixed fee pricing was more advantageous in the majority of instances. They performed a

quantitative comparison between two hypothetical companies using subscription-based and usage-based pricing and found that the fixed-fee-based producer had a distinct competitive advantage. Furthermore they point out that consumers themselves tend to prefer subscriptions to usage-based pricing, for good reasons: 1) insurance against sudden large bills because of increased usage; 2) consumers tend to think they use a service more than they actually do; and 3) consumers don't have to stop and think each time whether using the service is worth the additional cost. Producers also have reasons for preferring fixed-rate pricing, for example that customers tend to use the product more with fixed rate pricing, so that they become accustomed to the product faster.

2. Dissenting Viewpoints

a. Chuang and Sirbu

Chuang and Sirbu (1997) reported a quantitative study of Internet delivery of academic journal articles. They compared pure bundling, in which consumers can only access goods by paying a single fee, mixed bundling, in which consumers have a choice of whether to pay a single fee for all goods or to buy individual goods as needed, and pure unbundling, in which goods are available individually only. They found, in contrast to Bakos and Brynjolfsson, that pure bundling may in many cases be inferior to mixed bundling. Specifically, in cases where information goods exist in pure bundled form, such as newspapers, magazines, and academic journals, switching from pure bundling to mixed bundling may increase producer revenue. Thus journal publishers may benefit by offering customers the option to buy individual articles as well as traditional subscriptions. The benefits of doing this are greater if consumers positively value only a

subset of the bundle components, which the authors say is typically the case with academic journals.

b. Varian

Hal Varian, called by his peers the “godfather of Internet economics,” is the dean of the School of Information Management and Systems and a professor in the business school at the University of California, Berkeley. He has written and lectured extensively on various topics related to the Internet economy (1995, 1996). He believes that flat rate pricing is economically inefficient and instead has advocated a scheme of differential pricing, or setting different prices for different consumers and classes of service. He argues that a flat-rate pricing scheme is not economically viable because 1) it may exclude certain customers with lower valuations for the good, and result in lost revenue for others with higher valuations; and 2) it may not recoup enough revenue to cover the fixed costs. Information goods such as those provided by DecisionNet have high fixed costs, such as the computer and human resources used in development of the DSS technologies, and very low marginal costs. If a fixed-fee pricing scheme is used, the seller could set the fee at the level of the customer who has the lowest valuation for the good. But for a broad population of customers, the lowest customer valuation may be quite low, too low in fact to recover the fixed costs. On the other hand, he could set the fee at a higher level. But this would exclude a large segment of customers with lower valuations, possibly losing so much business that again he cannot recover the fixed cost. The solution is differential pricing: offering different prices each aimed at a different target segment. Varian described three degrees of price discrimination:

- First degree price discrimination means that the producer sells the good for a different price to each consumer and each price exactly equals that consumer's valuation for the good. This is also known as perfect price discrimination, because it extracts the maximum revenue possible from all consumers.
- Second degree price discrimination means that the producer sells for different prices based on how many units are purchased. An example of this is volume discounts. Consumers may be enticed to buy more units at a lower price per unit.
- Third degree price discrimination means that the producer sells at different prices to different market segments. Examples are senior citizen discounts and student discounts.

Varian points out that first degree price discrimination is an idealized situation and impossible to achieve in practice. But second and third degrees are close and frequently used substitutes. If a seller is faced with several market segments, a viable solution is to offer different price schedules each directed at a different segment. In order to recoup the fixed costs, the seller may combine this plan with a "two-part tariff": charging customers a membership fee, along with usage fees pegged to consumer valuations.

Varian also points out that, besides discriminating by price alone, sellers often discriminate along another dimension: quality of service. Examples of this are first-class and tourist-class seating on airliners, student versions of software with stripped-down capabilities, and stock quotes that are an hour old versus ones that are a few minutes old. In each case, the seller offers products with different features, at different prices, to practice price differentiation. It probably costs the seller the same to deliver

delayed stock quotes as immediate information, but it is preferable for him to delay the information in order to maintain the two-level price system.

B. BUSINESS PRACTICES

This section summarizes the marketing strategies and pricing policies of several online purveyors of information goods, comparable to DecisionNet. The intent is to provide a sampling of the sales policies for information goods that are used in practice. As in the academic studies described above, there seems to be no one scheme or policy that is universally preferred over others.

1. E-library

E-library (www.elibrary.com), cited by Bakos and Brynjolfsson, is a subscription-based repository of full-text newspapers, magazines, reports, transcripts, maps, and pictures. A monthly or annual subscription fee provides unlimited access to over 11 million newspaper articles, 800,000 magazine articles, 500,000 book chapters, 1,500 maps, 126,000 television and radio transcripts, and 93,000 photographs and images. The service also offers a 30-day free trial period, with the option to subscribe at the end.

2. r-cade

r-cade (www-rcade.dur.ac.uk) is a service run by the University of Durham in the United Kingdom which disseminates up-to-date economic, scientific, demographic, and environmental information about Europe, collected from the United Nations and other international agencies. Users can request information via the Internet or by phone, fax, or email. Users who have information sent via the Internet have a variety of pricing options:

- An annual registration fee is charged to all online users which covers the cost of printed manuals and helpdesk support.
- A usage fee is charged each year which covers a certain number of hours or of information downloads in that year. Customers who have a character-based Internet interface are charged by time. They can pay a certain amount for 45 hours of access per year, or larger amounts for 84, 140, or 220 hours of access. Customers who use a web browser are charged by download. They can pay varying amounts for 450 up to 2200 downloads in a year. The fee schedule is different for commercial and academic customers; academic customers are charged much less.
- In addition to up-to-date information, customers can use their hours or allotted accesses to browse the service's archives. These are not available online but must be requested by phone, fax, or email.
- The r-cade database also contains data provided by independent providers, such as Eurostat. The respective providers set the access fees for this data. The customer chooses which data to download and the system calculates and displays the charges before the customer actually runs the query and downloads the data.
- Academic users in the U.K. have the option to purchase an annual subscription for unlimited access to the database.

3. Advanced Information Databases, Inc.

Advanced Information Databases, Inc. (www.adinfo.com) is an online collection of databases on contracts for which the U.S. and other governments are presently accepting bids, and also European Union laws and legal texts. The system charges a one-

time registration fee of \$100 and an annual subscription fee of \$95. The contract database costs nothing to search; downloading a full length contract costs \$1.55 and downloading smaller texts costs \$0.80 or less. The system can also automatically perform daily searches, and email or fax summaries or full texts to a customer for a few dollars each. The database of European laws costs \$0.30 per minute to search, \$0.45 to download a summary, and \$1.70 to download a full text. The database of European legal texts costs nothing to search, and \$0.70 to retrieve a full document by ftp.

4. Clickshare Service Corporation

Clickshare (www.clickshare.com) is a Massachusetts-based startup which aims to serve as a consolidator and broker for Internet-based sellers of information goods. Consumers would pay Clickshare a subscription or usage-based fee, and it would provide access to hundreds of companies' web sites. Any company which sells its products over the Internet, such as newspapers, could do so through Clickshare's service. Any person who wished to buy a product over the Internet, could do so through Clickshare's service. The advantage to consumers is that they could purchase a wide variety of information goods from many companies and have only one user account and one billing statement to keep track of. The advantage to sellers is that Clickshare would be a worldwide presence, enabling them to make consumers aware of their products whom they could never reach on their own. Clickshare envisions that its service would charge consumers either by subscription or on a per-click basis. Each Clickshare customer would be provided an anonymous user ID. The service would keep track of how many times each user ID

viewed each page, at what times during the day. Sellers could use this demographic information to track web site and advertising hit rates and effectiveness.

5. Softlock.com

Softlock.com (www.softlock.com) is a reseller of information goods. It collects all types of digital or digitized products such as reports, books, news, or analytic information from providers and facilitates the marketing of those products. The unique features of Softlock's marketing strategy are:

- 1) "Chain Reaction Channel": Softlock makes samples of each product available for download on its web site. The samples are actually the full versions of each book, report, etc. but locked so that the user can only view a small part of it. When the consumer wishes to view the entire product, he or she sends name, address, and credit card information over a secure web connection and Softlock sends a computer-specific key which unlocks the product on that consumer's computer only. The chain reaction is that each consumer is encouraged to send the product to others who might be interested; they of course cannot view the entire product on their computers but must buy keys specific for their machines. The idea is that people who download the samples tend to create their own sales channels by passing them on to their acquaintances. Softlock keeps track of who buys each product and passes this information on to the product's provider as a prospect for other, related goods.
- 2) "Affiliate System": Vendors which participate in the Softlock system are encouraged to place ads for makers of other, related goods on their web sites. The vendors' web sites are made more compelling to consumers by the ads, leading to longer visits, and

the other makers get free advertising to consumers who are relatively likely to buy.

When a consumer buys the other makers' products, the host vendor receives a referral fee.

6. Air Force Times

The Air Force Times (www.airforcetimes.com) is an independent weekly newspaper covering topics of interest primarily to Air Force members. It is available both in printed form and on the web. The web site is purely subscription-based: the site contains the full text of a few articles each week and the first paragraph of others; viewing the full text of all articles each week as well as back issues requires a paid subscription.

7. Tutorials.com

Tutorials.com (www.tutorials.com) provides self-paced, multimedia training modules over the Internet on many different computer and business related topics. The subjects range from Microsoft certification exam preparation to time management to English as a second language. To use some of the modules, an ActiveX multimedia player is required which the site automatically downloads to the customer's computer. The customer selects the modules he wants from the online catalog and adds these to his "shopping cart." At checkout, the customer arranges payment and the modules are made available to him 24 hours a day for one month, six months, or one year. Prices vary. A one-month subscription to "Leadership Situations" costs \$29.95, and a six-month subscription costs \$49.95. A six-month subscription to "Implementing Windows NT Server" costs \$129.95 and a one-year subscription costs \$149.95. The advantage to the

customer is price. The customer can subscribe to modules he needs for as long as he needs them, at a lower cost than purchasing CDs.

8. Sony MusicLink

The March 25, 1999 issue of IDG.net (<http://www.idg.net/gomail.cgi?id=9-126853>) reported that Sony Corp. will begin beaming music by satellite to homes in Japan starting in May 1999. Customers will select songs with their television remote controls and then download them to a set-top receiver. The music will be transmitted by SkyPerfecTV, a digital broadcasting business in which Sony is an investor. Customers will also be able to save the music on Sony MiniDisc recorders. Charges are planned to range from US\$0.85 to US\$1.28 per download and the box will cost around US\$530. The article also mentioned that one of Sony's competitors, Nippon Telegraph & Telephone and Victor Co. recently announced a project to beam music from satellites to terminals in convenience stores, which customers will be able to store on discs. In addition, IBM and five leading record companies will test a cable-television based system in San Diego this year.

9. FutureLink

FutureLink (www.futurelink.net) was the first commercial company to offer downloadable software aimed at small businesses. FutureLink maintains a set of web servers loaded with standard office and business software. Clients run the software as needed through any web browser, on any machine including a 286 or Macintosh. FutureLink charges a subscription fee of \$299 to \$499 per seat per year, depending on the type of software needed, for unlimited access 24 hours a day. Clients save the costs of

buying standalone software, and avoid compatibility issues with their computers and other existing software. FutureLink takes care of issues such as backups, upgrades, and virus protection.

The conclusion drawn from all this is that the literature is not conclusively in favor of using any one pricing strategy in all circumstances. Depending on the consumer market and valuations for various goods, bundling and aggregation may or may not be advantageous for the producer. Therefore DecisionNet must be designed with a great deal of flexibility and freedom for the provider. The only way for each provider to decide on an optimum scheme is by experimenting, and DecisionNet must give him the ability to experiment.

C. DECISIONNET PRICING SCHEME

Brownlee (1996) proposed several fee structures for DecisionNet. These are summarized in the table below

Formulas

Flat Fee	$C = F$
Usage-based Fee	$C = IX$
Flat + Usage-based Fee	$C = F + IX$
Stepped Increments	$C = I_1X_1 + I_2X_2 + \dots$

where C = charge to DecisionNet consumers for use of technologies

F = a flat fee

X = number of accesses

I = a fee per access

I_1, I_2, \dots are incremental fees for a given range of accesses

X_1, X_2, \dots are ranges of accesses

The present implementation provides each of these options. The flat fee is represented by a subscription which the provider can ask of each consumer. The provider can ask in addition or alternatively for a usage based fee. The usage based fee can be based on the number of accesses, and/or the number of minutes spent at the technology site, and/or the number of pages downloaded at the site. The system also allows for incremental fees; however just one increment is provided. So the pricing options in the present system are:

$$C = F + I_1 X_1 + I_2 X_2 + J_1 Y_1 + J_2 Y_2 + K_1 Z_1 + K_2 Z_2$$

where J_1, J_2, \dots are incremental fees for a given range of minutes

Y_1, Y_2, \dots are ranges of minutes

K_1, K_2, \dots are incremental fees for a given range of downloads

Z_1, Z_2, \dots are ranges of downloads

The I's, J's, and K's are parameters chosen by the Provider and any or all can be zero.

The price information screen in DecisionNet appears below.

Technology Charges											
<i>To access the Technology directly the pricing plans are ...</i>											
Return to Consumer Menu											
To access the Technology, click one of the buttons below to select a pricing plan											
<input type="button" value="Subscription"/>											
<input type="button" value="Usage based"/>											
<u>Usage based charges:</u>											
<input type="text" value=".05"/>	per access for the first	<input type="text" value="5"/>	accesses plus \$	<input type="text" value=".1"/>	per access thereafter						
plus \$ <input type="text" value=".5"/>	per page for the first	<input type="text" value="100"/>	pages plus \$	<input type="text" value="1"/>	per page thereafter						
plus \$ <input type="text" value="0"/>	per minute for the first	<input type="text" value="0"/>	minutes plus \$	<input type="text" value="0"/>	per minute thereafter						
<i>To access the Technology through a package the pricing plans are ...</i>											
Return to Consumer Menu											
To access the technology, first highlight a package name in the list to the left, then click one of the buttons below to select a pricing plan											
<input type="button" value="Subscription"/>											
<input type="button" value="Usage based"/>											
<u>Usage based charges:</u>											
\$ <input type="text" value=".15"/>	per access for the first	<input type="text" value="100"/>	accesses plus \$	<input type="text" value=".2"/>	per access thereafter						
plus \$ <input type="text" value=".01"/>	per page for the first	<input type="text" value="300"/>	pages plus \$	<input type="text" value=".02"/>	per page thereafter						
plus <input type="text" value=".05"/>	per minute for the first	<input type="text" value="500"/>	minutes plus \$	<input type="text" value=".2"/>	per minute thereafter						
<table border="1"> <thead> <tr> <th></th> <th>PackageName</th> <th>TechnologyName</th> </tr> </thead> <tbody> <tr> <td>▶</td> <td>Pack2</td> <td>Tech2</td> </tr> </tbody> </table>							PackageName	TechnologyName	▶	Pack2	Tech2
	PackageName	TechnologyName									
▶	Pack2	Tech2									

Figure 3. Technology Price Screen

This screen informs the Consumer of the pricing parameters that the Provider chose for this Technology. The upper half of the screen shows the access, download, and time charges for accessing the Technology. The lower half of the screen shows the packages of which the Technology is a member, and the charges associated with each package.

V. CONCLUSION

A. REVIEW

This thesis has attempted to describe a proposed implementation of a pricing scheme for DecisionNet. The DecisionNet prototype serves as a facilitating agent between consumers who need to use decision support software, and providers who have developed such software and would like to make it available over the World Wide Web and possibly be compensated for this. DecisionNet is implemented as a database system, with remote data lookup and manipulation by means of a set of screens presented through standard web browsers. The prototype also may serve as a vehicle for collecting empirical data on pricing of information goods over the Internet, a field which is still relatively undeveloped.

B. SUGGESTIONS FOR FURTHER WORK

Below are several suggestions for further development and research:

1. Exploration of pricing schemes

This implementation of DecisionNet may serve as a means to begin collecting preliminary data on pricing schemes and consumer behavior for information goods over the Internet. The subscription- and usage-based pricing options available provide several combinations that can be explored. Providers may be inclined to experiment with different pricing schemes and adjust the parameters to see the effect on usage of their technologies.

2. Security

If DecisionNet begins to actually charge consumers for use of providers' technologies, implementation of security measures will become imperative. Presently, user IDs and passwords are sent over the Internet in the clear. Some secure encryption scheme must be implemented to encode these identification data before they are sent. Additionally, because the DecisionNet database records personal identification data on consumers and providers and information concerning their technology usage, reasonable measures must be taken to ensure this database is secure from unauthorized access and tampering, as well as backed up in case of hardware failure or accidental damage.

3. Additional pricing options

Over time, the DecisionNet prototype may be expanded to provide additional pricing options as deemed appropriate. For example, the chapter on Pricing above mentioned Bakos and Brynjolfsson's claim that disaggregation over time, that is, charging different rates depending on the time of day, may be advantageous.

4. Exclusive Technologies

DecisionNet may be expanded to allow for exclusive technologies. Work in this area would consist of generation of a user interface for exclusive technologies that do not provide their own interfaces.

APPENDIX

This appendix is intended as a user's guide for the present implementation of DecisionNet. It describes the operation of the system as a consumer and provider.

A. CONSUMER OR PROVIDER

The starting screen of DecisionNet is pictured below.

DecisionNet - The Next Generation (alpha version)

Start DecisionNet

If you are not currently registered as a DecisionNet Consumer or Provider, please take a few moments to register in order to make full use of DecisionNet functionality.

Open Consumer Session

User Name:

Password:

Open Provider Session

User Name:

Password:

[Click here to Register as Consumer](#) [Browse Technologies](#) [Click here to Register as Provider](#)

[Leave DecisionNet](#)

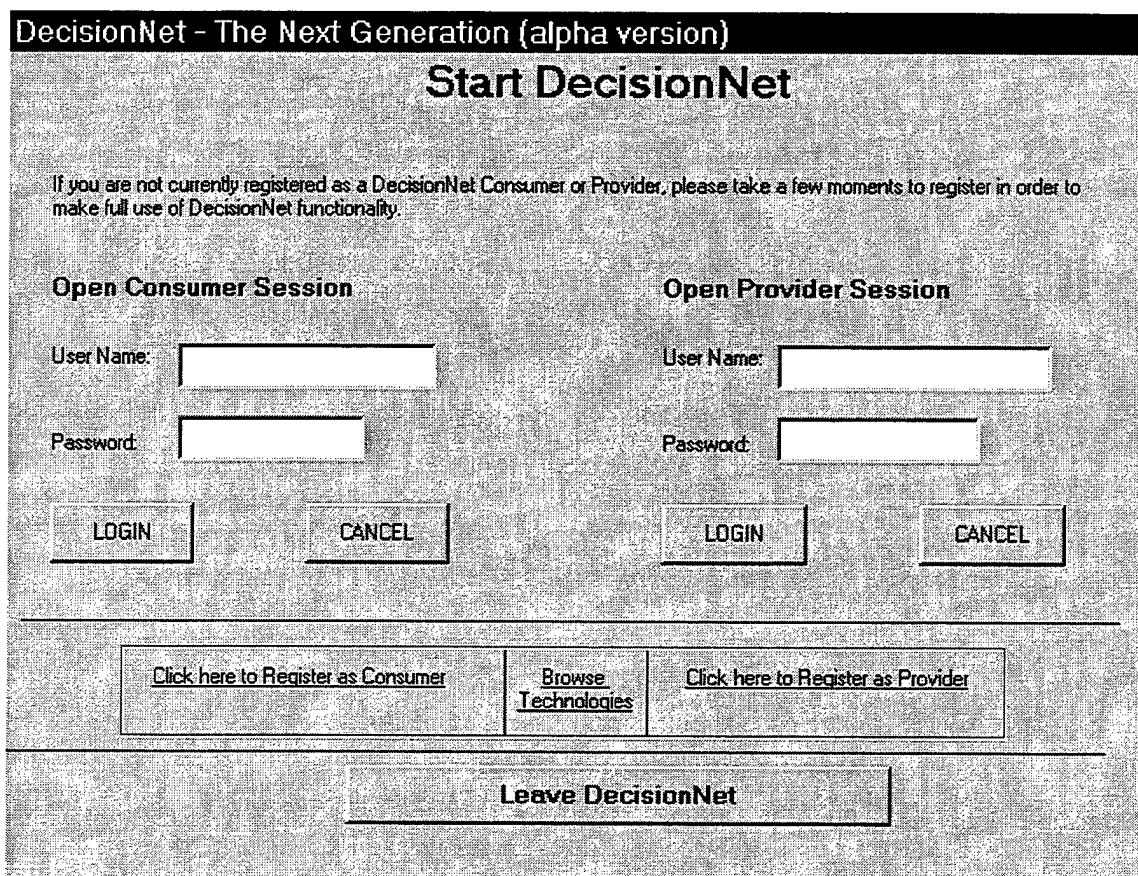


Figure 4. Starting Screen

This is the starting point for all DecisionNet consumer and provider actions. Clicking on one of the three links at the bottom of the screen enables you to establish a consumer account, establish a provider account, or view of list of registered technologies.

1. Browse Technologies

The center link, "Browse Technologies," brings you to this screen which shows a list of all registered technologies, along with their providers' names, object types, and problem areas:

DecisionNet Technologies

This is a list of all registered technologies. These technologies are owned and maintained by their individual providers. DecisionNet's purpose is to facilitate access to these technologies.

If you want to access any of these technologies, you must first register as a DecisionNet Consumer by clicking on the "Register as Consumer" button. To return to the Consumer menu, click on "Return to Menu".

Technology Name	Provider Name	Object Type	Problem Area
CTech	Provider1	Decision Support	Assignment
Tech1	Provider1	ALL	ALL
Tech1	Provider2	ALL	Asset Pricing
Tech2	Provider1	ALL	ALL

[Register as Consumer](#) [Return to Menu](#)

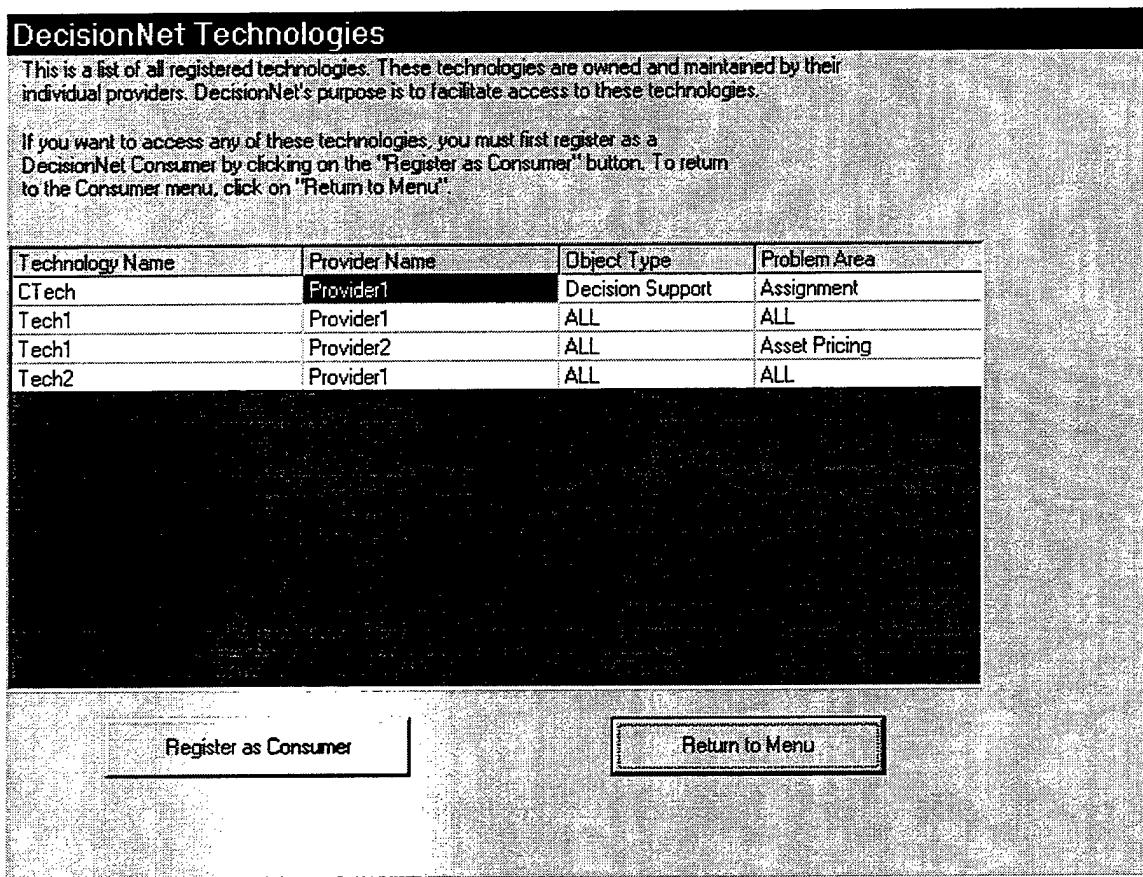


Figure 5. Browse Technologies Screen

2. Consumer

a. Registering as a consumer

In order to access any of these technologies, you first have to register as a DecisionNet consumer. You can click on the left button, "Register as Consumer," or you can return to the start screen and click on the left link at the bottom to register as a consumer. The consumer registration screen looks like this:

Consumer Registration

DecisionNet Consumer Registration

Please fill in all of the following fields, then click the "Sign Me Up!" button. For your Consumer ID, enter a string of letters and/or numbers up to 15 characters long. Your Consumer ID must be different from all other users, so if you choose one that already exists, you will be prompted to try again. Select your Consumer ID carefully; you cannot change it later. Your password

Consumer ID:	<input type="text"/>
Password:	<input type="password"/>
Re-type Password:	<input type="password"/>
Last Name:	<input type="text"/>
First Name:	<input type="text"/>
E-Mail Address:	<input type="text"/>

Figure 6. Consumer Registration Screen

All fields are required. For the Consumer ID, choose any alphanumeric string up to 15 characters long. *Choose carefully, because you cannot change this later.* If the Consumer ID you choose is already taken by another consumer, you will be prompted to enter a different one. After you have filled in all the boxes, click on “Sign Me Up!.” You can also click on “Clear Form” to empty all of the boxes, or “Cancel Registration” to return to the start screen.

After the system has validated and recorded all of your entries, you are shown a welcome screen:

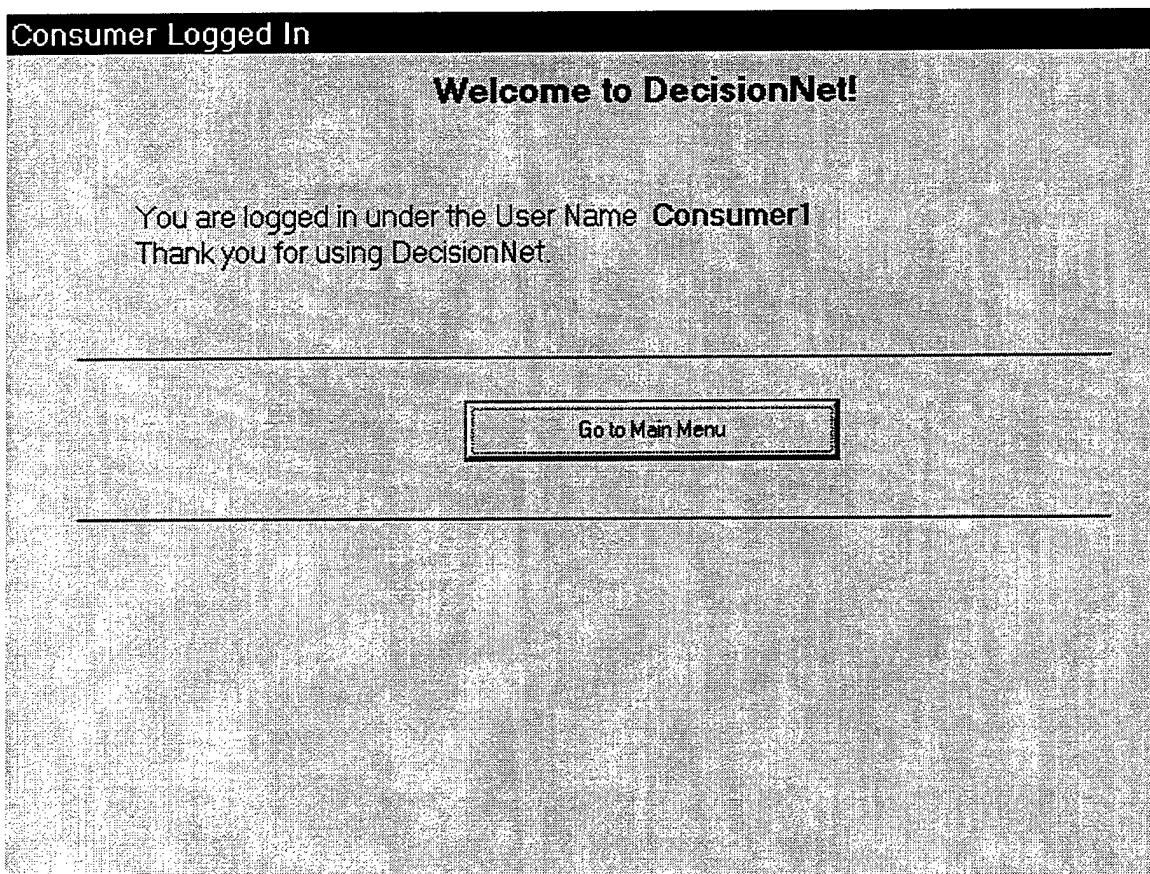


Figure 7. Consumer Welcome Screen

Click on “Go to Main Menu” to go to the consumer menu and start using DecisionNet.

b. Using DecisionNet as a consumer

This is the consumer menu:

DecisionNet Consumer Menu

List Technologies Obtain a listing of all technologies sorted by: <input type="text" value="Technology Name"/> <input type="button" value="▼"/> <input type="button" value="List Technologies"/>	Bookmarked Technologies <table border="1"><thead><tr><th>ProviderName</th><th>TechName</th></tr></thead><tbody><tr><td> </td><td> </td></tr></tbody></table> <input type="button" value="Access this Technology"/> <input type="button" value="Unbookmark this Technology"/>	ProviderName	TechName		
ProviderName	TechName				
Access Technology If you already know the Provider name and name of the technology you wish to use, please select them. <input type="button" value="Select"/>	Provider Name: <input type="text" value="Provider1"/> Technology Name: <input type="text" value="CTech"/> <input type="button" value="View Details"/>				
Indexed Search DecisionNet technologies are classified in six categories. Define your search criteria by choosing a term from each category. <input type="button" value="Modify My Login Info"/> <input type="button" value="Display My Account and Subscription Info"/> <input type="button" value="Withdraw from DNet"/> <input type="button" value="Logout"/>	Object Type: <input type="text" value="ALL"/> Problem Area: <input type="text" value="ALL"/> Functional Area: <input type="text" value="ALL"/> Solution Method: <input type="text" value="ALL"/> Industry Type: <input type="text" value="ALL"/> Organization Type: <input type="text" value="ALL"/> <input type="button" value="Find Technologies"/>				

Figure 8. Consumer Menu

The menu is divided into five sections. Each section provides a separate function.

The upper left corner of the menu enables you to view a list of all technologies, sorted by technology name, provider name, object type, or problem area, depending on which item you select from the dropdown list. This list is similar to the one produced by clicking on the “Browse Technologies” link in the start screen.

The upper right corner enables you to select a technology from those that you have bookmarked. Since you have just established your account, nothing appears in

the list. Later, if you find yourself using particular technologies relatively often, you can bookmark them for faster access. (See “Accessing DecisionNet Technologies” below.) To remove a technology from the bookmarked list, click on “Unbookmark this Technology.”

Just below the bookmark list is a section that enables you to search for technologies registered by a particular provider. There are two dropdown lists. The upper list, labeled “Provider Name,” shows all registered providers. If you highlight a provider’s name, the lower list is automatically populated with the names of technologies that that provider has registered. After you select a provider in the upper list and a technology in the lower list, click on “View Details” to view a screen which shows more details about that technology, and enables you to access that technology (see “Accessing DecisionNet Technologies” below).

Just below that, in the lower right corner of the menu, is the indexed search area. You can enter preferences for any or all of the six taxonomy categories and the system will return a list of registered technologies that exactly match your criteria. If you have no preference for a category, leave it as the default of “ALL.”

Finally, in the lower left corner of the menu, is the administrative area. Clicking on “Modify My Login Info” brings up this screen:

Modify Consumer Information

Modify Consumer Information

Directions:

1. Please enter your current password in the "Current Password" field (even if you are not changing your password).
2. For the remaining fields, modify any information that you want to change, then press the "Modify Record" button. If you do not want to change a piece of information, do not modify the entry in that field.
3. You cannot change your Consumer ID using this page. If you need to change your Consumer ID, please contact us.
4. If you change your password, you must type in all three password fields (current, new, and new again) for the change to take effect.

Current Password:	<input type="text"/>
New Password:	<input type="text"/>
Re-type New Password:	<input type="text"/>
Last Name:	White
First Name:	Jack
E-Mail Address:	jackwhite@email.com
<input type="button" value="Save my changes"/> <input type="button" value="Clear Form"/> <input type="button" value="Return to Consumer Menu"/>	

Figure 9. Modify Consumer Information Screen

which enables you to change your password, name, and email address which you provided at registration. Simply delete the old entry in each field and type the new entry. You must enter your current password in order to save your changes, even if you are not changing your password.

The next button down in the menu, "Display my Account and Subscription Info," enables you to view your account balance and technologies to which you have a subscription. "Withdraw from DecisionNet" permanently closes your DecisionNet consumer account, and "Logout" ends your active session.

c. Accessing DecisionNet Technologies

The “List Technologies” button in the upper left corner of the consumer menu, and the “Find Technologies” button in the lower right corner, both produce lists of technologies. Here is what the “List Technologies” button might produce:

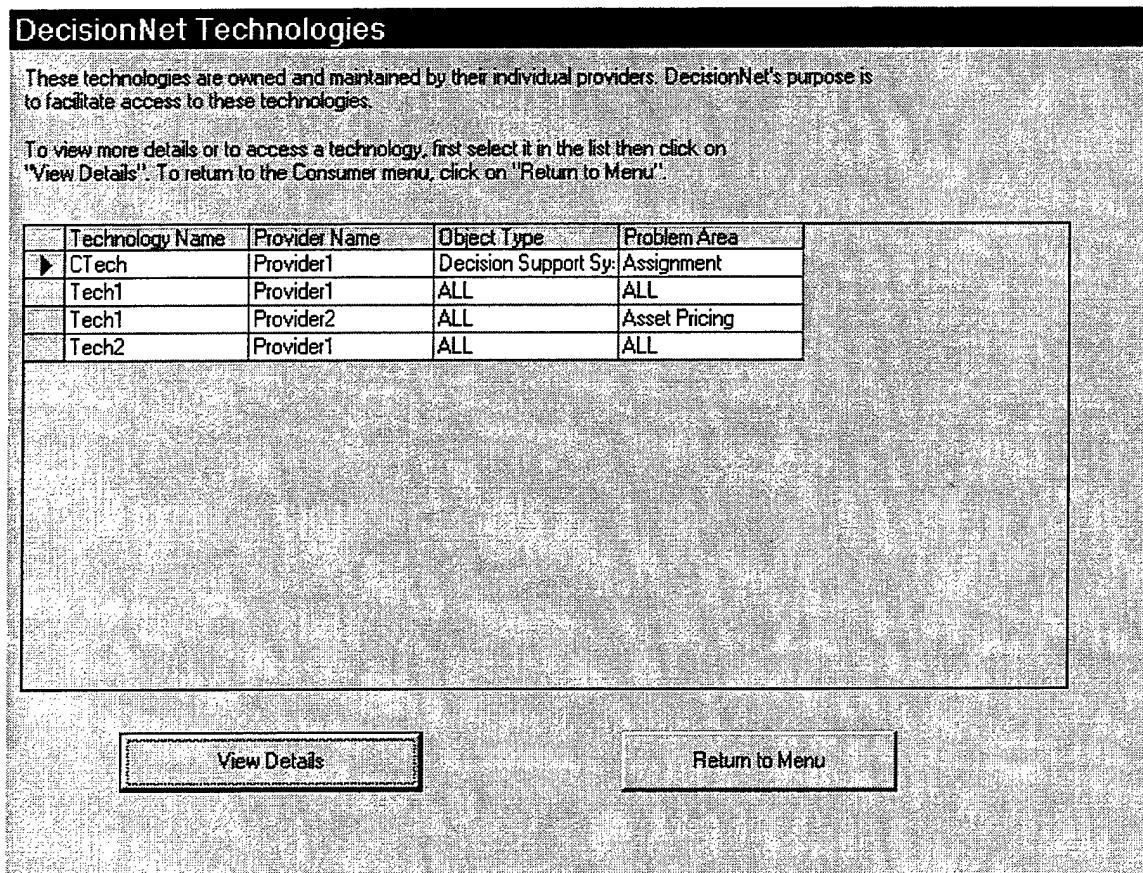


Figure 10. List Technologies Screen

To view further information about a technology, highlight any part of the row where the technology name appears. Then click the “View Details” button at the bottom of the screen. The technology details screen appears.

Technology Details

Decision Technology Details

Below are more details about the technology you selected. To begin executing this technology, click on "Access Technology". To return to the Consumer menu, click on "Return to Consumer Menu".

Technology Name:	Tech1	Object Type:	ALL
Provider Name:	Provider1	Problem Area:	ALL
Date Registered:	1/15/99 8:45:00 PM	Functional Area:	ALL
Last Updated:	1/15/99 8:45:00 PM	Solution Method:	ALL
		Industry Type:	ALL
		Organization Type:	ALL

Purpose:

Comments:

[View Usage Charges](#)
[Bookmark this Technology](#)
[Return to Consumer Menu](#)

Figure 11. Technology Details Screen

This screen also appears if you click the “View Details” button on the right side of the consumer menu. It shows the technology and provider names, dates the technology was registered and last updated, the six taxonomy categories, and any purpose and comments entered by the provider.

This screen provides the way to bookmark technologies for faster access in the future. If you click “Bookmark this Technology,” the technology name is added to your list of bookmarks and henceforth appears in the bookmarks list in the consumer menu.

To access this technology, click "View Usage Charges." The usage charges screen is brought up.

Technology Charges		To access the Technology directly the pricing plans are ...		To access the Technology, click one of the buttons below to select a pricing plan													
<u>Subscription price</u>	\$ 30 per month			<input type="button" value="Return to Consumer Menu"/>	<input type="button" value="Subscription"/>												
				<input type="button" value="Usage based"/>													
To access the Technology through a package the pricing plans are ...				Return to Consumer Menu													
<u>Subscription price</u>	\$ 10 per month	<table border="1"> <thead> <tr> <th>PackageName</th> <th>TechnologyName</th> </tr> </thead> <tbody> <tr> <td>Pack1</td> <td>Ctech</td> </tr> <tr> <td>Pack2</td> <td>CTech</td> </tr> </tbody> </table>		PackageName	TechnologyName	Pack1	Ctech	Pack2	CTech	To access the technology, first highlight a package name in the list to the left, then click one of the buttons below to select a pricing plan							
PackageName	TechnologyName																
Pack1	Ctech																
Pack2	CTech																
				<input type="button" value="Subscription"/>	<input type="button" value="Usage based"/>												
<u>Usage based charges:</u> <table> <tr> <td>\$ <input type="text" value="0"/></td> <td>per access for the first <input type="text" value="0"/></td> <td>accesses plus \$ <input type="text" value="0"/></td> <td>per access thereafter</td> </tr> <tr> <td>plus \$ <input type="text" value="0"/></td> <td>per page for the first <input type="text" value="0"/></td> <td>pages plus \$ <input type="text" value="0"/></td> <td>per page thereafter</td> </tr> <tr> <td>plus \$ <input type="text" value="0"/></td> <td>per minute for the first <input type="text" value="0"/></td> <td>minutes plus \$ <input type="text" value="0"/></td> <td>per minute thereafter</td> </tr> </table>				\$ <input type="text" value="0"/>	per access for the first <input type="text" value="0"/>	accesses plus \$ <input type="text" value="0"/>	per access thereafter	plus \$ <input type="text" value="0"/>	per page for the first <input type="text" value="0"/>	pages plus \$ <input type="text" value="0"/>	per page thereafter	plus \$ <input type="text" value="0"/>	per minute for the first <input type="text" value="0"/>	minutes plus \$ <input type="text" value="0"/>	per minute thereafter		
\$ <input type="text" value="0"/>	per access for the first <input type="text" value="0"/>	accesses plus \$ <input type="text" value="0"/>	per access thereafter														
plus \$ <input type="text" value="0"/>	per page for the first <input type="text" value="0"/>	pages plus \$ <input type="text" value="0"/>	per page thereafter														
plus \$ <input type="text" value="0"/>	per minute for the first <input type="text" value="0"/>	minutes plus \$ <input type="text" value="0"/>	per minute thereafter														

Figure 12. Usage Charges Screen

This screen shows the charges that the provider has specified for this technology. The upper half of the screen shows the charging options for accessing the technology individually. In the case shown above, the only way to access the technology is to buy a subscription at \$30 per month. If you click "Subscribe," the system will check whether you already have a subscription to this technology. If not, you will be asked whether you want to buy a subscription. If you answer "Yes," you will be subscribed and immediately sent to a browser screen where the system will attempt to access the technology's web

page. Henceforth, your account will be charged \$30 per month and you will have unlimited access to this technology through DecisionNet, until you cancel your subscription (see “Display Account and Subscription Information” below).

The lower half of the usage charges screen shows the charging options for accessing the technology through a package. A package is a group of two or more technologies to which one pricing scheme is attached. For example, if a provider creates a package consisting of Technology A and Technology B and assigns a subscription price of \$40 per month to the package, then for \$40 per month consumers have unlimited access to both Technology A and Technology B. In this case, the technology belongs to two packages. Each package may have different prices. As you scroll through the list of packages, the prices in the box will change to match the package currently selected.

In the figure above, the package selected has a monthly subscription price associated with it. It also has usage-based prices: a certain amount per access for the first X number of accesses, then another amount per access thereafter; a certain amount per minute for the first X minutes, then another amount per minute thereafter; and a certain amount per page downloaded for the first X downloads then another amount thereafter. The number of accesses is cumulative; that is, the system keeps track of how many times you have accessed this technology and charges accordingly. For a package, each time you access any of the technologies in that package, that counts as one access. However, you are charged for an access only if the first web page successfully downloads. The minute charge is also cumulative. The minute charge starts after the first page is successfully downloaded and continues until you close the browser screen. If the first page does not download successfully, you are not charged any minutes. The download charge is also

cumulative. Each time you click on a hyperlink in the technology's web page, or click the forward or back buttons in the web browser, counts as one download.

To accept a package's subscription price, highlight the row where the package name appears and click "Subscription" in the lower half of the usage charge screen. The system will check whether you already have a subscription to this package. If not, you will be asked whether you want to buy a subscription. If you answer "Yes," you will be subscribed and immediately sent to a browser screen where the system will attempt to access the technology's web page. To accept a package's usage-based price, highlight the row where the package name appears and click "Usage based" in the lower half of the usage charge screen. This will send you to a browser screen where the system will attempt to access the technology's web page.

3. Provider

a. Registering as a provider.

Registering as a DecisionNet provider enables you to add decision support technologies to the database which consumers can browse and access. To register as a provider, click the link labeled "Click Here to Register as Provider" at the bottom of the DecisionNet start screen. This brings you to the provider registration screen, which is similar to the consumer registration screen.

Form1

DecisionNet Provider Registration

Please fill in all of the following fields, then click the "Sign Me Up" button. For your Provider ID, enter a string of letters and/or numbers up to 15 characters long. Your ID must be different from all other users, so if you choose one that already exists, you will be prompted to try again. Select your Provider ID carefully; you cannot change it later. Your password can be up to 10 characters long. To cancel the registration process, click "Cancel Registration".

Provider ID:	<input type="text"/>
Password:	<input type="password"/>
Re-type Password:	<input type="password"/>
Name:	<input type="text"/>
Home Page URL:	<input type="text"/>
E-Mail Address:	<input type="text"/>
<input type="button" value="Sign Me Up!"/> <input type="button" value="Clear Form"/> <input type="button" value="Cancel Registration"/>	

Figure 13. Provider Registration Screen

For the Provider ID, choose any alphanumeric string up to 15 characters long. ***Choose carefully, because you cannot change this later.*** If the Provider ID you choose is already taken by another consumer, you will be prompted to enter a different one. You must also enter a password (twice), a name, and an email address. After you have filled in those boxes, click on "Sign Me Up!." You can also click on "Clear Form" to empty all of the boxes, or "Cancel Registration" to return to the start screen. After the system has validated and recorded all of your entries, you are shown a welcome screen:

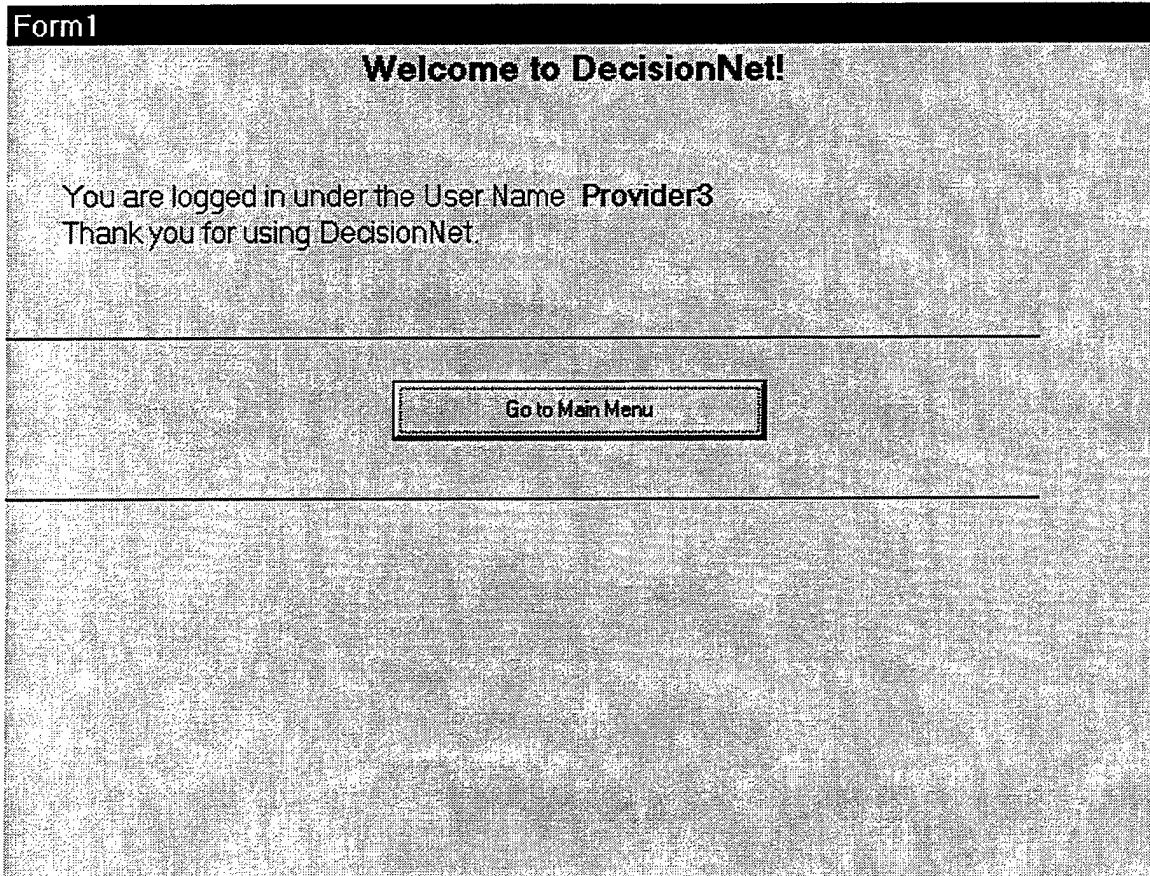


Figure 14. Provider Welcome Screen

Click on “Go to Main Menu” to go to the provider menu and begin using DecisionNet.

b. Using DecisionNet as a provider

This is the provider menu:

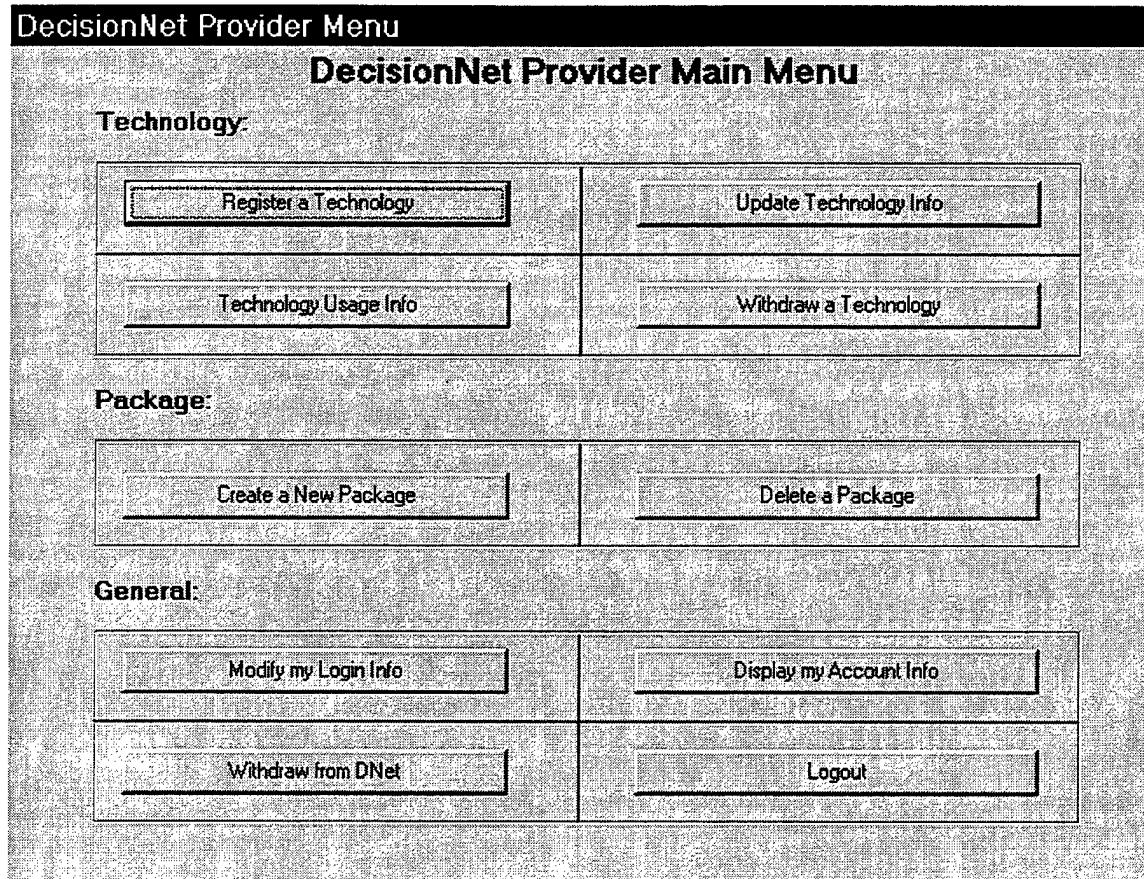


Figure 15. Provider Menu

The menu is divided into three parts. The upper part enables you to register, update, and withdraw technologies. The middle part enables you to create and delete packages. The lower part handles administrative functions: modifying DecisionNet registration information, displaying account balance, and withdrawing or logging out of DecisionNet.

Clicking on “Register a Technology” brings you to the technology registration page:

Register a Technology

Technology Name:	<input type="text"/>		
Object Type:	<input type="button" value="▼"/>	Solution Method:	<input type="button" value="▼"/>
Problem Area:	<input type="button" value="▼"/>	Industry Type:	<input type="button" value="▼"/>
Functional Area:	<input type="button" value="▼"/>	Organization Type:	<input type="button" value="▼"/>
URL:	<input type="text"/>		
Purpose:	<input type="text"/>		
Comments:	<input type="text"/>		
<input type="button" value="View Instructions"/> <input type="button" value="Continue Registration"/> <input type="button" value="Cancel and Return to Provider Menu"/>			

Figure 16. Technology Registration Screen

For the technology name, enter any alphanumeric string up to 50 characters long. The name cannot match that of any technology or package that you previously registered, even if you subsequently withdrew the technology or deleted the package. If the name is the same as a previous technology or package, you will be prompted to select a different one. You must also make a selection from the dropdown list boxes for each of the six taxonomy categories, as well as enter a URL for the technology (include the http:// or equivalent at the beginning). The other fields, purpose and comments, are optional. When you are done, click on “Continue Registration” to enter price information for this

technology. You can also click on “Cancel and Return to Provider Menu” to cancel the registration.

The price information screen looks like this:

Access Charge Information

How would you like Consumers to be charged for using this Technology?

Your options are to charge a fixed monthly subscription fee or to charge each Consumer based on how much he or she uses the Technology. If you check both boxes below, then each Consumer will be allowed to choose whether to pay a subscription fee or pay charges according to usage. Whichever option you select, you must fill in the appropriate amount in each box corresponding to that option.

Select one or both:

Offer a subscription Assess charges based on usage

Subscription price of \$ per month

Usage charges of:

\$ <input type="text" value="00.00"/>	per access for the first <input type="text" value="000"/>	accesses plus \$ <input type="text" value="00.00"/>	per access thereafter
plus \$ <input type="text" value="00.00"/>	per page for the first <input type="text" value="000"/>	pages plus \$ <input type="text" value="00.00"/>	per page thereafter
plus \$ <input type="text" value="00.00"/>	per minute for the first <input type="text" value="000"/>	minutes plus \$ <input type="text" value="00.00"/>	per minute thereafter

Register Technology **Cancel Registration**

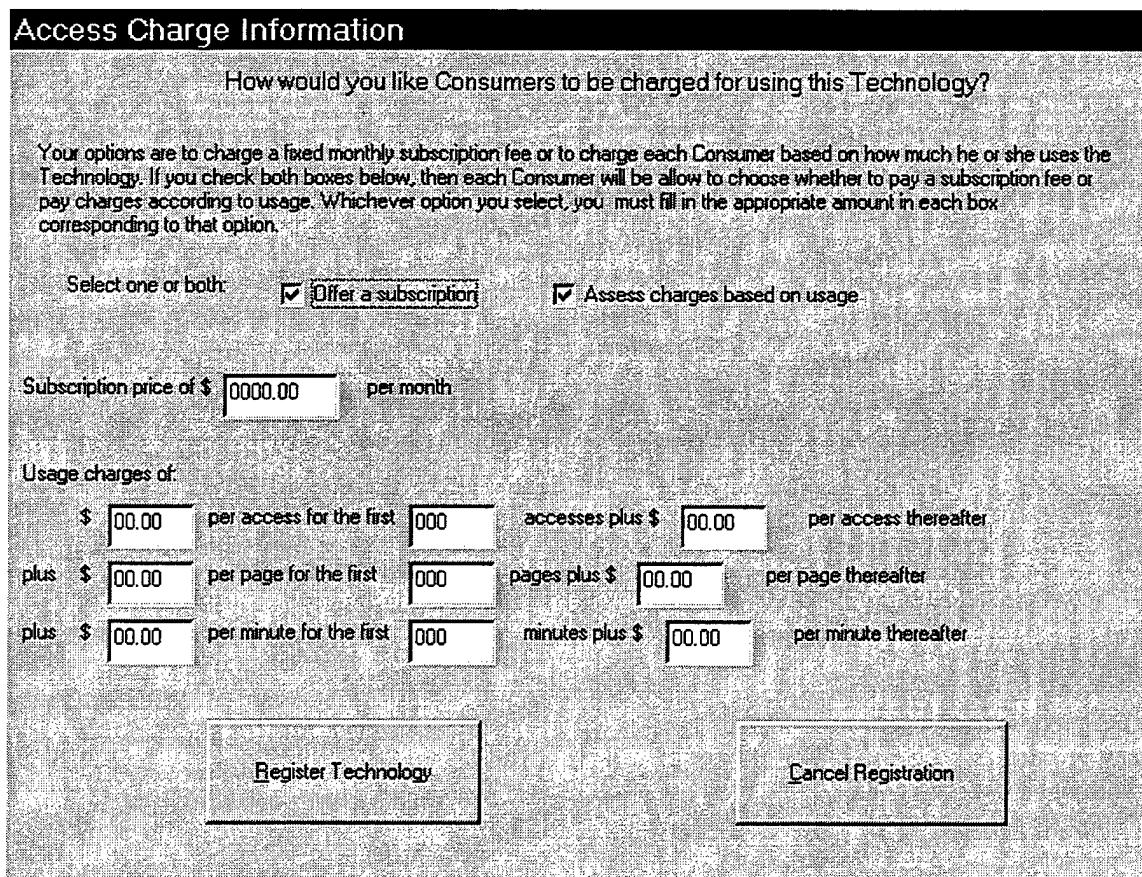


Figure 17. Technology Pricing Screen

Your options are to require consumers to buy a subscription or to charge consumers according to usage. You can select both options and allow the consumer to choose. If you check the “Offer a Subscription” box, you must enter a subscription fee greater than or equal to zero in the box. If you check “Assess Charges Based on Usage” then you must enter a fee greater than or equal to zero in each of the six boxes at the bottom of the screen. See part 2.c. above for an explanation of each of these charges. When you are

done, click “Register Technology.” You can also click “Cancel Registration” to cancel the technology registration and return to the provider menu.

Clicking on “Update Technology Info” produces this screen:

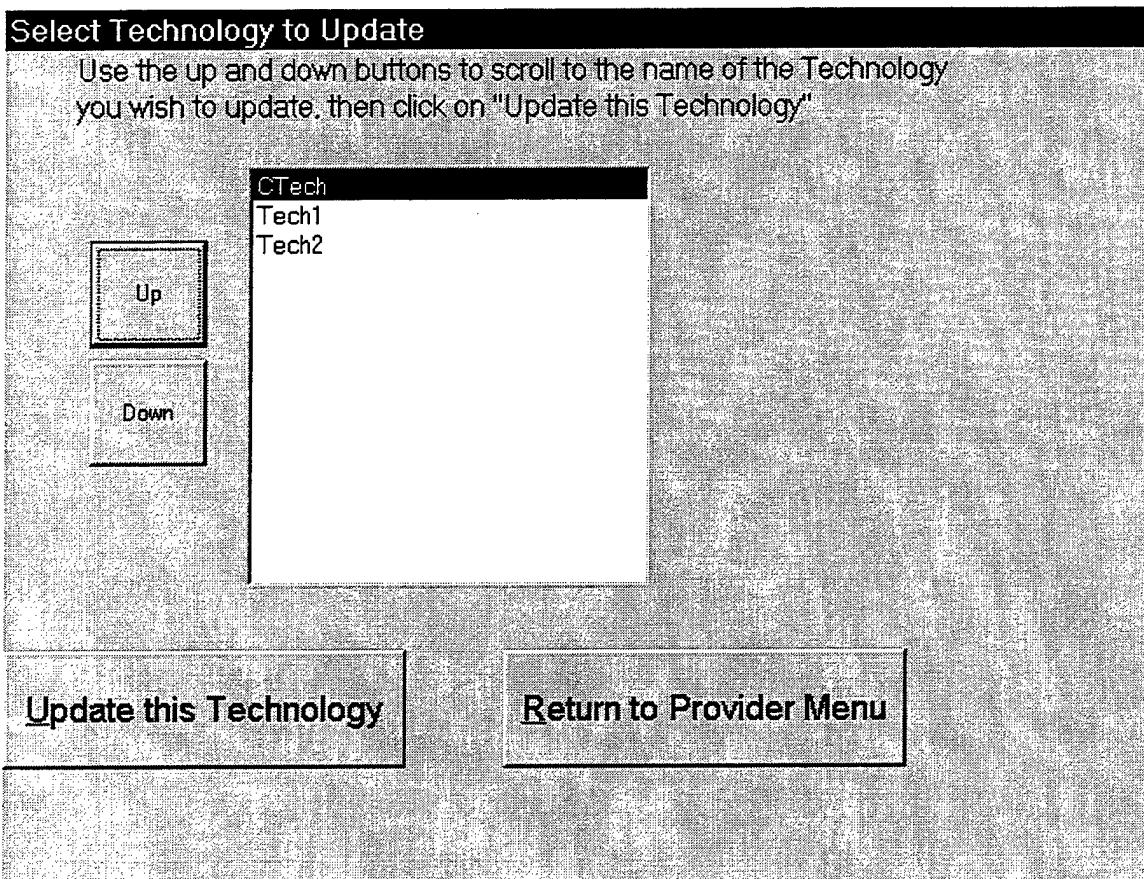


Figure 18. Update Technology Selection Screen

which shows a list of the technologies that you have registered. Click the up or down buttons to select a technology name and then click “Update this Technology.” A screen appears showing the information you provided for this technology.

Update Technology Information

Technology Name:	Tech2
Object Type:	ALL
Problem Area:	ALL
Functional Area:	ALL
Solution Method:	ALL
Industry Type:	ALL
Organization Type:	ALL
URL:	www.dmdc.osd.mil
Purpose:	(Large empty text area)
Comments:	(Large empty text area)

Buttons at the bottom:

- Save my changes
- Update Consumer usage charges
- Return to Provider Menu

Figure 19. Update Technology Information Screen

You can modify any field except the technology name. If you make any changes, be sure to click “Save my changes” to update the database. Then click “Update Consumer usage charges” if you want to modify the pricing information; otherwise click on “Return to Provider Menu.”

The screen to update technology charges looks and functions just like the one to set the charges at registration:

Update Charges

How would you like Consumers to be charged for using this Technology?

Your options are to charge a fixed monthly subscription fee or to charge each Consumer based on how much he or she uses the Technology. If you check both boxes below, then each Consumer will be allowed to choose whether to pay a subscription fee or pay charges according to usage. Whichever option you select, you must fill in the appropriate amount in each box corresponding to that option.

Select one or both:

Offer a subscription

Assess charges based on usage

Usage charges of:

\$ <input type="text" value="00.05"/>	per access for the first <input type="text" value="005"/>	accesses plus \$ <input type="text" value="00.10"/>	per access thereafter
plus \$ <input type="text" value="00.50"/>	per page for the first <input type="text" value="100"/>	pages plus \$ <input type="text" value="01.00"/>	per page thereafter
plus \$ <input type="text" value="00.00"/>	per minute for the first <input type="text" value="000"/>	minutes plus \$ <input type="text" value="00.00"/>	per minute thereafter

[Save my changes](#)

[Return to Provider Menu](#)

Figure 20. Update Technology Prices Screen

Again, if you make any changes on this screen, be sure to click “Save my changes.”

Clicking on “Withdraw Technology” brings up a list of technologies that you have registered.

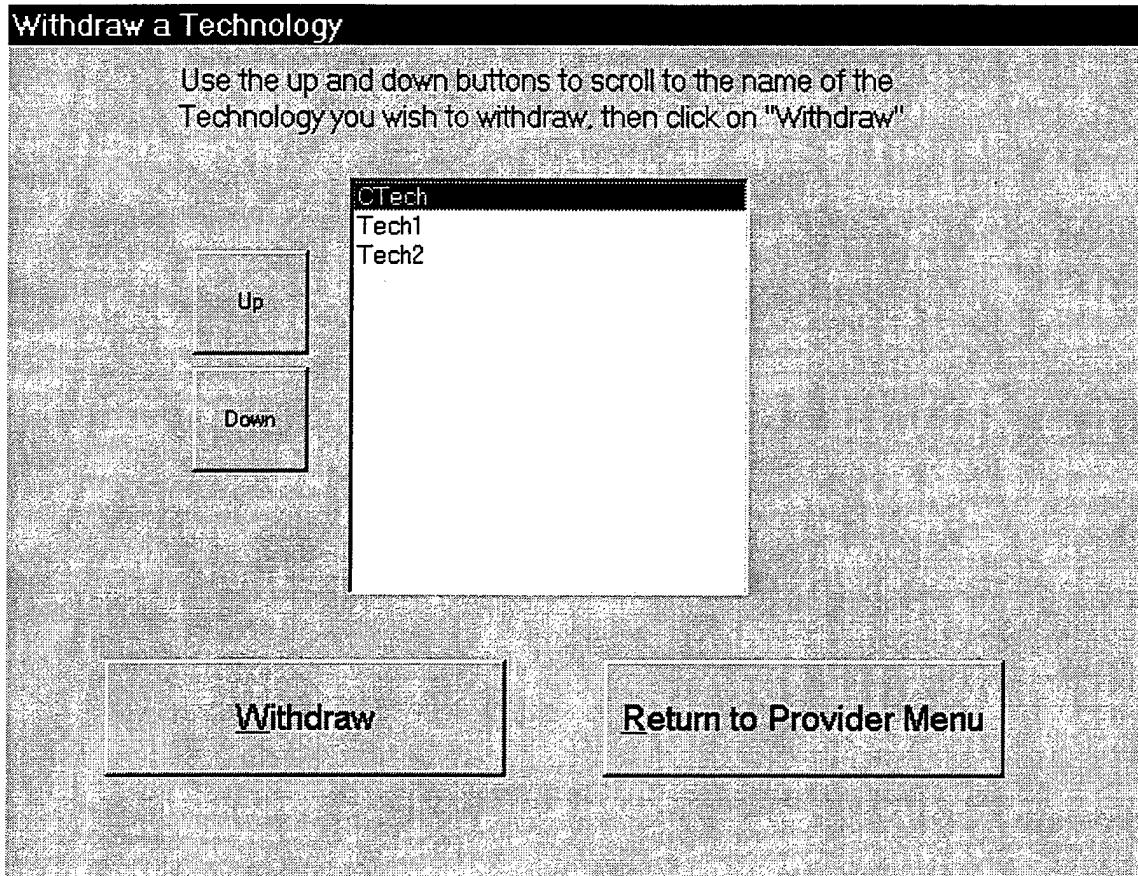


Figure 21. Withdraw Technology Screen

Click the Up or Down button to highlight the technology to withdraw, then click "Withdraw."

To create a package, click "Create a package." The Create Package screen appears.

Create a new Package

Package Name: <input type="text"/>	Technologies to include (highlight two or more): <input type="checkbox"/> CTech <input type="checkbox"/> Tech1 <input type="checkbox"/> Tech2												
<p>How would you like Consumers to be charged for using Technologies in this Package?</p> <p>Your options are to charge a fixed monthly subscription fee or to charge each Consumer based on how much he or she uses the Technologies in the package. If you check both boxes below, then each Consumer will be allowed to choose whether to pay a subscription fee or pay charges according to usage. Whichever option you select, you must fill in the appropriate amount in each box corresponding to that option.</p> <p>Select one or both:</p> <p><input checked="" type="checkbox"/> Offer a subscription <input checked="" type="checkbox"/> Assess charges based on usage</p> <p>Subscription price of \$ <input type="text"/> 0000.00 per month</p> <p>Usage charges of:</p> <table border="0"> <tr> <td>\$ <input type="text"/> 00.00</td> <td>per access for the first <input type="text"/> 000</td> <td>accesses plus \$ <input type="text"/> 00.00</td> <td>per access thereafter</td> </tr> <tr> <td>plus \$ <input type="text"/> 00.00</td> <td>per page for the first <input type="text"/> 000</td> <td>pages plus \$ <input type="text"/> 00.00</td> <td>per page thereafter</td> </tr> <tr> <td>plus \$ <input type="text"/> 00.00</td> <td>per minute for the first <input type="text"/> 000</td> <td>minutes plus \$ <input type="text"/> 00.00</td> <td>per minute thereafter</td> </tr> </table>		\$ <input type="text"/> 00.00	per access for the first <input type="text"/> 000	accesses plus \$ <input type="text"/> 00.00	per access thereafter	plus \$ <input type="text"/> 00.00	per page for the first <input type="text"/> 000	pages plus \$ <input type="text"/> 00.00	per page thereafter	plus \$ <input type="text"/> 00.00	per minute for the first <input type="text"/> 000	minutes plus \$ <input type="text"/> 00.00	per minute thereafter
\$ <input type="text"/> 00.00	per access for the first <input type="text"/> 000	accesses plus \$ <input type="text"/> 00.00	per access thereafter										
plus \$ <input type="text"/> 00.00	per page for the first <input type="text"/> 000	pages plus \$ <input type="text"/> 00.00	per page thereafter										
plus \$ <input type="text"/> 00.00	per minute for the first <input type="text"/> 000	minutes plus \$ <input type="text"/> 00.00	per minute thereafter										
<input type="button" value="Create New Package"/> <input type="button" value="Cancel"/>													

Figure 22. Create Package Screen

You must assign a name to the package, up to 15 characters long. The name must not match that of any technology or package you have previously registered. You must also select at least two technologies to include in the package, from the list at the right side of the screen. If you have not registered at least two technologies, you cannot create a package at this time. In the lower part of the screen, you can choose a prices for this package. This pricing section looks and functions the same as the pricing screen for an individual technology and gives you the same two options of subscription or usage-based pricing. When you are done, click “Create a New Package.”

The “Delete a Package” screen enables you to delete a package that you have created. It brings up a list of packages.

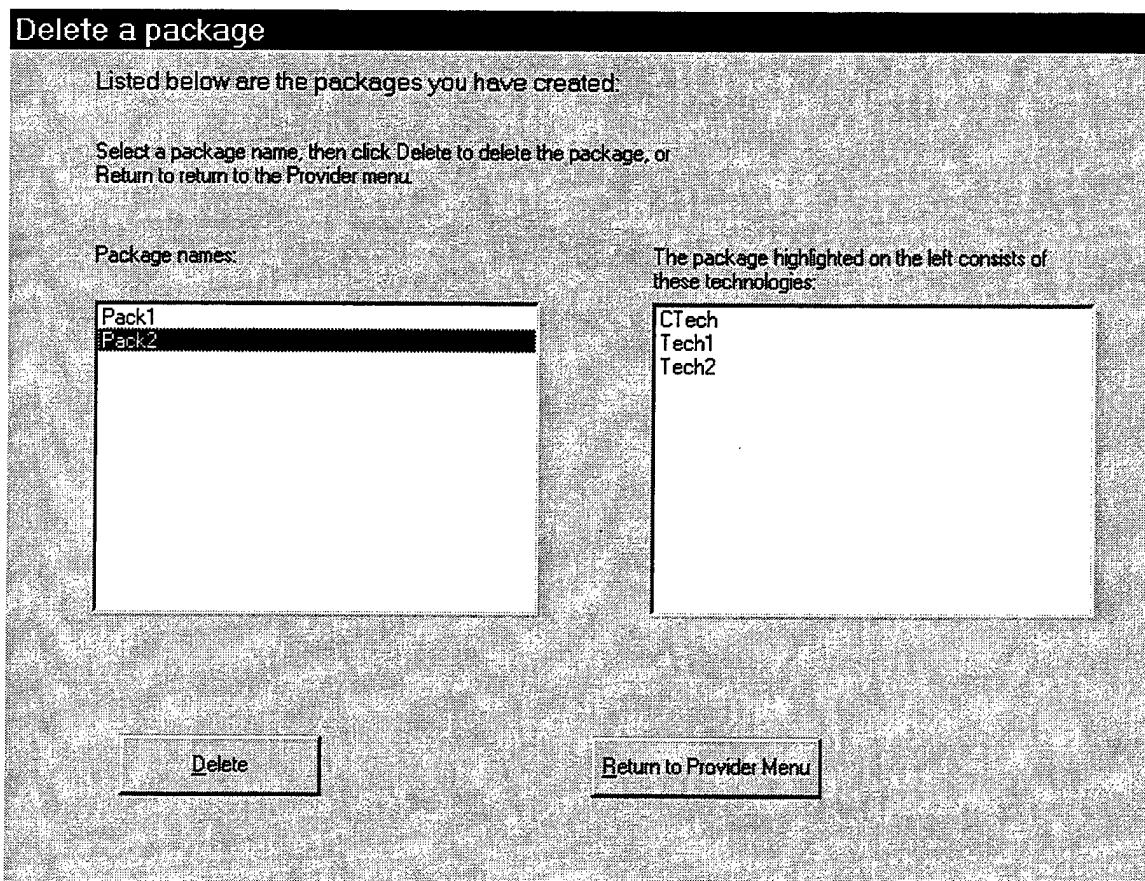


Figure 23. Delete Package Screen

As you highlight each package name in the list, the list on the right shows the technologies which belong to that package. Click “Delete” to delete the highlighted package.

REFERENCES

Adams, W.J. and Yellen, J.L., "Commodity Bundling and the Burden of Monopoly," *Quarterly Journal of Economics* 90: 475-490 (1976).

Amundsen, Michael. *Using Visual Interdev 6*. Indianapolis: Que Corporation, 1999.

Bakos, Y. and Brynjolfsson, E. (1997). "Aggregation and Disaggregation of Information Goods: Implications for Bundling, Site Licensing, and Micropayment Systems." Presented at the Conference on Internet Publishing and Beyond: The Economics of Digital Information and Intellectual Property, Kennedy School of Government, Harvard University, Cambridge, MA, June 1997.

Bakos, Y. and Brynjolfsson, E. (1998). "Bundling Information Goods: Pricing, Profits and Efficiency." Working paper, Massachusetts Institute of Technology. Available at <http://www.gsm.uci.edu/~bakos> and <http://ccs.mit.edu/erik>

Bhargava, H.K., King, A.S., and McQuay, D.S., "DecisionNet: An Architecture for Modeling and Decision Support Over the World Wide Web." *Proceedings of the Third International Conference on Decision Support Systems*, Vol. 2, June 1995.

Brownlee, David Glen. *Pricing Information Services in Electronic Markets: Case Study of DecisionNet*. Master's Thesis, Naval Postgraduate School, Monterey, CA, March 1996.

Chuang, J.C.-I. and Sirbu, M.A. "Network Delivery of Information Goods: Optimal Pricing of Articles and Subscriptions," Jan 1997. Presented at the Conference on Economics of Digital Information and Intellectual Property, Cambridge, MA, Jan 23-25, 1997.

Earley, Steven H. *DecisionNet: A Database Approach*. Master's Thesis, Naval Postgraduate School, Monterey, CA, September 1996.

Fishburn, Peter, Odlyzko, Andrew M., and Siders, Ryan. "Fixed Fee Versus Unit Pricing for Information Goods: Competition, Equilibria, and Price Wars." *FirstMonday: Peer-Reviewed Journal on the Internet*, Issue 2_7, (1997). Available at http://www.firstmonday.dk/issues/issue2_7/odlyzko

Fedorov, A., Francis, B., Harrison, R., Homer, A., Murphy, S., Smith, R., Sussman, D., and Wood, S. *Professional Active Server Pages 2.0*. Birmingham, UK: Wrox Press, 1998.

Hatfield, Bill. *Active Server Pages for Dummies*. Foster City: IDG Books, 1998.

InternetTrak: A telephone survey of the adult population in France, Germany, and the U.K. commissioned by Ziff-Davis, Dell and Yahoo! Conducted in September 1998. Results at <http://www.zdnet.co.uk/zdm/netsurvey>

Rogers, Patricia. *Indexing and Retrieval in Digital Libraries: Developing Taxonomies for a Repository of Decision Technologies*. Master's Thesis, Naval Postgraduate School, Monterey, CA, March 1996.

Toub, Steve. "Sponsored and Fee-Based Revenue Options for an Internet Digital Library," Working paper, University of Michigan, 15 Dec 1995.

Turban, Efraim and Aronson, Jay E., *Decision Support Systems and Intelligent Systems*, 5th ed. New Jersey: Prentice-Hall, 1998.

Varian, H. "Pricing Information Goods." *Proceedings of Scholarship in the New Information Environment*, a symposium at Harvard Law School, May 1995.

Varian, H. "Differential Pricing and Efficiency." *FirstMonday: Peer-Reviewed Journal on the Internet*, Issue 2 (1996). Available at
<http://www.firstmonday.dk/issues/issue2/different>

Visible Analyst Workbench, computer software, Visible Systems Corporation, Waltham, MA, 1996.

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